

The Biology of the Fungus-growing Ants. Part IX. The British Guiana Species.

By Neal A. Weber, University of North Dakota

(With 5 text-figures and 8 plates)

The general biology of the British Guiana species of Attini forms the subject of the present paper. It follows similar studies of the Barro Colorado Island, Panama Canal Zone and Trinidad, B. W. I. faunas. Earlier parts of the series were devoted mostly to the classification or taxonomy of this tribe of ants and included descriptions of many new species.

British Guiana has an area of less than 90,000 square miles and lies well within the tropical belt, mostly between 9° and 1° North Latitude. It has only a small area of land, lying in the central west as an extension from Venezuela, which would be high enough to acquire possibly a temperate climate. The continuation east of the so-called Guiana Highlands along the southern border appears to be too low for any appreciable change of climate. Inland from the low, sandy to swampy coast the land rises in a series of escarpments which are the cause of the waterfalls, the best known being Kaieteur. Most of the colony, however, lies under 1000 feet (300 meters) above sea level and a large part is under 500 feet (150 meters). Normal surface temperature at all times of the year averages above 68° Fahr. (20° C.). A broad belt extends inland from the coast and has an annual rainfall in the neighborhood of 100 inches (250 cm.) which rivals the wettest part of the Amazon basin. The rainfall decreases slightly in belts paralleling the coast but in the driest parts, the savannah districts, it is still 40-60 inches (100-150 cm.).

The colony lies in the middle of the Guianan Sub-region, the sub-region of lowlands lying between the Orinoco and Amazon Rivers, and the greater part is covered by magnificent rain forests. The ant fauna is typically South American and this area may well have been a center of speciation for such rain forest genera as *Apterostigma*, *Sericomyrmex* and *Trachymyrmex*. Although some 45 species and subspecies are here listed from this colony the number of kinds is certainly greater, probably by at least 50%.

The only part of the country which has been much altered by civilization is a narrow coastal belt and this has been intensively cultivated for centuries, beginning with the Dutch in the 16th Century. Parts of the nearby forests have been intermittently exploited for valuable hardwoods but without changing the

forests greatly. The scattered and few Indians fell small tracts of forests for their plots of cassava and maize but the forests soon regain control, with a different floral composition of course. The gold and diamond miners have small workings which do not have an appreciable effect on the vegetation. A large part of the colony has a population density of less than two persons per square mile. For an excellent study of a small sample area of forest see Davis and Richards (1933-34).

In 1935 and again in 1936 I was able to visit the colony for a few weeks each and am indebted to several men for courtesies. The Colonial Secretary made it possible for me to stay at the Colony House in the clearing of the Forest Settlement, Mazaruni River. The Director of Agriculture, Hon. J. Sidney Dash, and the Conservator of Forests, Hon. B. R. Wood, facilitated my stay here in 1935. Messrs. Roser and Tuxhorn accommodated me in their goldmining camp along the Oko River in 1936 and later, through the offices of Major Phipps, R. E., I was able to visit uninhabited and unexplored country near the Surinam-Brazilian boundaries as the guest of the British Section of the British Guiana-Surinam-Brazil Boundary Commission.

The known biology of the British Guiana species is described below under the genera, beginning with *Cyphomyrmex* and ending with *Atta*. The observation nests refer to those which I was able to keep in the Colony House at the Forest Settlement, site also of His Majesty's Penal Settlement.

Experiments in Trinidad demonstrated that fungus-growing ants would feed upon fungi growing wild in nature or upon fungi from nests of other species and genera of Attini. Dr. G. Walcott also found ants of an *Acromyrmex coronatus* colony cutting a wild sporophore, eating some fragments and taking others into the nest in Pará, Brazil. Unpublished experiments in Trinidad showed that the ants would eat certain mono- and disaccharides and make use of various other pure organic chemicals as substrate for their gardens. These experiments with chemicals were continued in British Guiana.

The experiments, described below under the species of ant involved, demonstrated that dextrin, blood fibrin and hemoglobin could be taken into the nest and used as substrate for the fungus. Either the fungus was capable of acting upon these substrates enzymatically and then digesting them, or they furnished a largely passive support, the fungus using ant fecal droplets for food. Ant and other arthropod skeletons were used for substrate as

previously recorded in the Panama Canal study. The ants themselves fed freely upon maltose.

Cyphomyrmex

Cyphomyrmex rimosus Spinola

Mem. Accad. Sc. Torino, 13: 65, 1851, worker, male.

The most widely distributed of all fungus-growing ants is *C. rimosus*, described from Pará, Brazil. It is, however, one of the smallest and most inconspicuous species and has not hitherto been recorded from British Guiana except as food of the giant toad, *Bufo marinus* (Weber, 1938) and a brief reference to a Mazaruni nest in a tree in my study of Canal Zone Attini (1941).

The species undoubtedly occurs throughout the colony. Although the workers do not deviate markedly from two millimeters in length, the ants show considerable variation, especially in development of thoracic tubercles and proportions of the postpetiole, so that several forms have been named. The exact status of these forms awaits examination of the types of the species and determination of the normal limits of variation. The biology of all of the forms that I have examined is essentially similar as may be seen from the descriptions of the nests given here under the species and under the subspecies *curiapensis* and *trinitatis*.

A colony at the edge of the clearing of the Forest Settlement, Mazaruni River on August 15, 1935 nested at the side of a ditch in heavy shade. Only in the morning would sunlight for a time fall upon the site. The nest was in a damp humus — sand — debris mixture and was in the form of the customary irregular cavities. On elongated pieces of substrate, including probably some insect feces, numerous pale brown bromatia were lying. The nest was placed in a Petri dish and by next morning the ants had segregated the brood and fungus garden, each in open cells which were contiguous. August 19 at 8 a.m. the ants were given squares of paper on which were small piles of the following pure chemicals: blood fibrin, peptose, dextrin and gelatin. 10 minutes later workers were busily engaged in taking to the fungus garden masses of the dextrin. These were placed against the masses of bromatia. A worker went over to such a mass of dextrin, licked it, then applied the tip of the gaster and defecated an amber fecal droplet which was immediately absorbed. 25 minutes later nearly all of the dextrin had been removed and most had

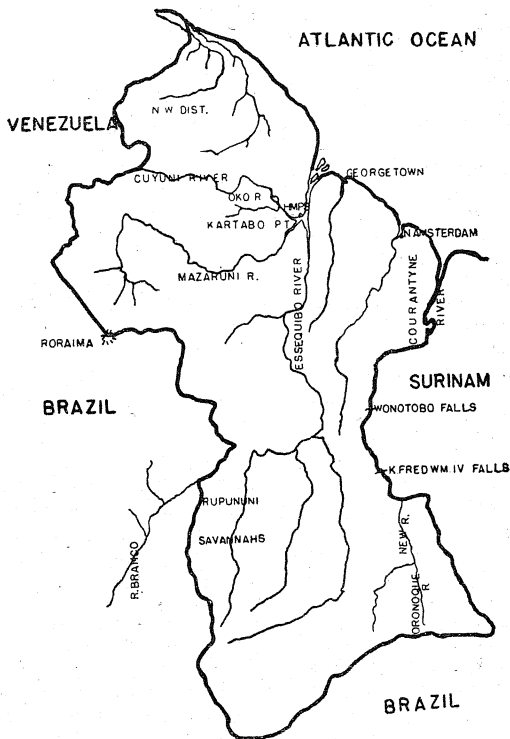


Fig. 1. Map of British Guiana showing chief localities from which ants are known. HMPS — His Majesty's Penal Settlement and the Forest Settlement as well.

already taken on an amber color from the fecal droplets. A number of bromatia had been planted on the dextrin. At 9:50 a.m. workers were still exploring their container, evidently seeking more substrate. A worker held a bromatium and rotated it while rasping the piece with its mouthparts. By the afternoon of August 21 the chemicals had been largely removed except for peptose, a large fragment of blood fibrin and some semi-liquid gelatin. These were removed from the container. At 3:40 p.m.

they were given similar squares of paper with egg albumen, hemoglobin, diastase and maltose. Five minutes later the ants were removing maltose in masses. They would rotate the mass between the mouthparts, sometimes two workers sharing one, and then would take it out of sight below into the next. At 3:55 the ants were still carrying maltose and by 5:15 nearly all had been removed. Some of the ants had been seen to feed on it directly. By 7 a.m. August 22 all maltose above the nest had disappeared and the egg albumen and diastase had liquefied. These were removed. At 11:20 a.m. August 24 a few workers, which I had isolated August 21 and which had nothing to eat in the interval, were given a fragment of the fungus garden of a colony of *Cyphomyrmex bigibbosus faunulus*. This garden was of the fluffy mycelial type common to this tribe of ants and very different from that of the *rimosus* forms. Three or four ants immediately came up to the fragment, explored it with the antennal tips and one or two even bit it momentarily. None, however, attempted to taste the piece. For five or ten minutes several ants remained near the fragment but without tasting it. The main nest of ants at 4 p.m. was given dextrin, diastase, blood fibrin, hemoglobin, egg albumen and maltose. 50 minutes later all of the maltose had been removed, either to one side of their fungus garden or on it. Nothing else had been touched. By the next morning a little blood fibrin had been removed and the egg albumen, diastase and dextrin liquefied. In the meanwhile the isolated workers with the alien garden were still ignoring it except that a tiny amber fecal droplet had been deposited on the fragment. The colony was preserved August 25 and consisted of 56 workers, two dealate females, one worker pupa, larvae and bromatia. The ants and bromatia had flourished on the pure organic chemicals from August 19 to 25. By this latter date not only had the maltose been used but the remainder of the blood fibrin and fully one-third of the hemoglobin. Under a 20× hand lens bromatia of varying sizes could be distinctly seen stuck to wet pieces of both the fibrin and the hemoglobin (Fig. 2).

A colony near the Forest Settlement nested August 17, 1935 in savannah vegetation at the edge of the Mazaruni River. The ants nested in yellowish sand five centimeters from the entrance to an *Atta sexdens* sens. str. nest and at a depth of three centimeters. They had the usual fungus garden with brown bromatia. The *Cyphomyrmex* nest was entirely within a small *Atta* crater and about one centimeter above the surrounding soil

level. A few centimeters away from the crater and 15-20 cm. from the *Atta* entrance were nests of two small ponerine ants, *Holcaponera striatula* Mayr and a genus near *Wadeura*, but at depths of 12-15 cm.

Other nests were found in the vicinity of the Forest Settlement. One was taken at a height of 92 feet in a *Cassia* tree and has been briefly noted earlier (Weber, 1941). The tree was 195 feet high and was obligingly felled for me by Indian woodsmen since the operations of the Forestry Department would have eventually required the felling at any rate. The ants nested between roots of a giant aroid epiphyte in the vegetal detritus. At this height there could be no soil proper, only humus from the breakdown of plant remains. The tangle of roots was tight, which would have permitted only tenuous chambers. The ants "feigned death" readily. As much as possible of the nest was gathered August 25 and placed in a container. August 28 at 7 a.m. five bromatia were transferred in one mass to a sterile tube of maltose agar. By 9:30 a.m. August 29 ten bromatia could be seen. Several of these were very small and were between other larger ones. This is evidence that the bromatia are formed by the fungus alone and by budding. In most artificial cultures, however, the fungus grew into irregular ribbons instead of additional bromatia. The colony was ended at 11 a.m. and in the original container few bromatia survived.

Also here on August 19 and 30, 1935 were taken specimens of the giant toad (*Bufo marinus* L.) (*loc. cit.*) which had workers of this species, among other ants, in their stomachs. The ants, however, may have been accidentally snapped up in taking larger ants.

The species occurred 22½ miles west of Kartabo Point, between the Cuyuni and Mazaruni Rivers. Ants that were taken here, however, were unusually small and pale. A worker taken July 25, 1936 near the outlet of the Oronoque River near the junction with the New River of the Courantyne system belongs to the species. It was found on the top of a half rotted log.

Cyphomyrmex rimosus curiapensis Weber

Rev. Ent., 9: 190, 1938, worker, female, male.

In the high, virgin rain forest of the Orinoco Delta, Venezuela is the type locality for this form and it has not hitherto been recorded elsewhere. The type colony nested in humus about the

roots of an epiphyte on a tree trunk at an elevation of nearly two meters above the ground; a meter below was a nest of *Acromyrmex octospinosus*.

In a similar habitat at Wonotobo Falls on the upper Courantyne River a colony was taken July 12, 1936. The ants nested two meters above the ground in a rotted cavity of a tree. The ants were not only carrying insect feces for substrate for their gardens but were carrying other miscellaneous material, including woody fibers which were lying on the ground. The ecology of the two places differed, however, in that the Orinoco locality was subject to periodic flooding while the Courantyne situation was a rain forest on sandy soil, probably not commonly inundated, if at all.

Cyphomyrmex rimosus ssp. *trinitatis* Weber

Rev. Ent., 9: 189, 1938, worker, female.

The type locality of *trinitatis* is the island of Trinidad and I have since recorded it from the Panama Canal Zone (1940, 1941). It is a sharply sculptured form which is probably of fairly wide distribution. Ants which were taken near the Forest Settlement, Mazaruni River, along the Oko River of the Cuyuni system, along the Courantyne River above the entrance of the Lucie River and below the King Frederick Falls, and near the junction of the Oronoque River with the New River of the Courantyne system appear to belong to *trinitatis*.

Two colonies were taken in swamp rain forest back of the Forest Settlement. Both nested under bark on a fallen tree at a height of 125 cm. above the ground. The site was densely shaded and would receive only spots of sunlight and these at midday. One colony contained many pupae; 84 cm. distant on the same log occurred a nest of *Cyphomyrmex bigibbosus faunulus*. The other colony was distant from the *faunulus* colony about 40-50 cm. The ants nested among the debris on top of the log in humus and among rotted leaves under epiphytes. Some males took flight when the nest was exposed. There was a large number of bromatia, some of which were scattered on damp, half-rotted leaves as though they had developed *in situ*. Defecation of the ants would assist in the nourishment of the fungus. The ants, which were collected August 21, 1935, were kept alive until August 29. They maintained a number of bromatia during this

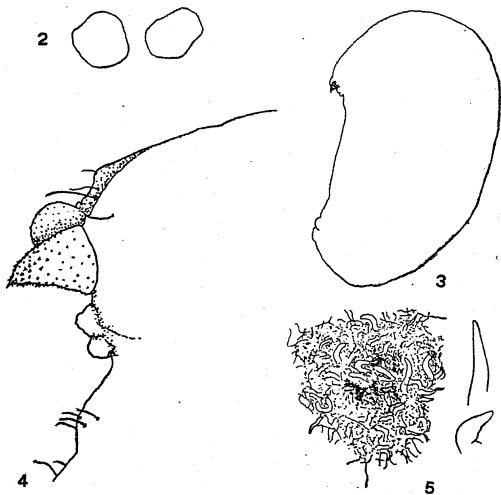


Fig. 2. *Cyphomyrmex rimosus*, outline of two bromatia, 0.27-0.28 mm. in diameters. — Fig. 3. *Trachymyrmex phippsi*, outline of larva. — Fig. 4. *Trachymyrmex phippsi*, lateral view of mouthparts of larva of Fig. 3, showing stout, spinulose mandible and the sparse hairs. — Fig. 5. *Trachymyrmex phippsi*, bromatium 0.6 mm. in diameter with ends of two hyphae enlarged at right.

period but these were pale with only a tinge of brown. They were given no artificial substrate. Several *Strumigenys* ants were in the soil about the nest and collected with the *Cyphomyrmex*.

A third colony near the above swamp rain forest nested at the base of a sand ridge in high forest. An old tree stump had a hollow center and in this were several ponerine ants and a colony of this species.

Several miles away in a magnificent virgin greenheart forest a colony nested a meter above the ground under the bark of a dead liana. There was a large fungus garden and, separately placed, a scattered mass of larvae and pupae. 196 workers, 9 alate females and 2 males were collected. The brood included 22 pupae whose sex could be determined (10 female, 8 worker, 4 male). The ants used the head and legs of a worker *Pachycondyla crassinoda* in their garden.

Another colony near here nested in a shallow cavity at a depth of a meter in one of several rotted blocks of wood of a huge mass of debris forming the nest of *Acromyrmex coronatus globoculis*. On a log in high rain forest by the Oronoque River a colony was taken 67 mm. from the initial garden of a *Cyphomyrmex bigibbosus tumulus* female. The *rimosus* nested in a cell 55×40 mm. in rotted wood under debris which was crowded with the fungus garden. The garden consisted of uniform, woody insect feces with bromatia of the usual *rimosus* type. The ants were active and somewhat elusive.

In a loose mass of vegetal debris in the aerial roots of a tree at a height of about 125 cm. in virgin rain forest along the Oko River a colony nested. The fungus garden consisted of bromatia, typical in appearance, growing on insect feces of various kinds. Brood was present in the irregular mass of dead leaves, twigs, etc. A nest of this kind with delicate fungus could only exist in a site such as this provided that the humidity was always excessively high. The site was near a stream in a depression and everything was saturated with moisture.

One worker was taken along the Courantyne River between the Lucie River and King Frederick Falls in rain forest on white sand such as occurs at the Forest Settlement, Mazaruni River. The ant was accidentally picked up while collecting colonies of termites and a *Leptogenys* at a brief noon stop while traveling upstream.

Cyphomyrmex bigibbosus Emery (Plate 1)

Bull. Soc. Ent. Ital. 26: 226, 1894, worker.

Emery described *bigibbosus* from Pará, Brazil and subspecies are recorded from Bolivia and British Guiana. It has not hitherto been recorded in its typical form from British Guiana except in my key to the genus in 1940 and an example of a curiously discontinuous distribution is my recent description of a female from Trinidad. The latter appears to be a relict. In the far interior of British Guiana, however, along the Oronoque River of the Courantyne drainage I found a number of colonies in high rain forest July 20-29, 1936. This type of forest contained Brazil nut (*Bertholletia* sp.) and was otherwise unlike rain forest of more coastal areas. The ants were compared with topotypes and were similar. Several workers had very slightly shorter "ears" (occipital corners) and several had less pruinosity but these appeared to be well within the normal range of variation.

One colony was nesting in an abandoned termite mound, the others on rotted wood. The termite nest contained several termites but was otherwise abandoned and was resting on the ground. The fungus garden was honeycombed, 23 mm. in maximum diameter and about 13 mm high. The substrate was light yellow-brown but included part of an insect chitinous skeleton. The noteworthy feature of the garden was the presence of bromatia as large and distinctly compact as any present on higher Attini gardens. These occurred only in several places on the garden which were seemingly unmodified. A female was present.

A nest in rotted wood was 80 cm above the ground, being in the crotch of a moss-covered prostrate dead tree. There were two gardens, one 105×75 mm; the other a few millimeters away and 50×35×30 mm (Plate 1). Both were sessile. This garden also had well-developed bromatia and was gray in color externally, brown internally. Males and at least one queen were present.

In rotted wood on the ground the largest garden measured was 115 mm long and 20-35 mm high, being entirely pendant on completely saturated wood. The garden was divided into several portions by air spaces, one being about 5 mm from another and 22 mm high × 28 mm diameter, with polygonal cells 2-4 mm in diameter. This portion appeared new and was fluffy in texture. Several inner cells were lined with large, white, elliptical, compact bromatia. The entire garden was suspended by mycelia and these were in ridges corresponding to the separated portions and the cellular structure. The larvae were swathed in mycelia and the workers were colored exactly as the wet wood in which they were nesting. A worker picked another up by the thorax and held the ant perpendicularly as it walked. In the same rotted log was another nest with a garden even larger which may have been part of a polydomus colony. This also had distinct bromatia and yellow-brown substrate. 15 cm from the first nest was a *Trachymyrmex phippsi* garden which closely resembled the *Cyphomyrmex* garden except for greater compactness and smaller size.

Another nest in rotted wood was unusual in having numerous fragments of ant skeletons (ponerines, *Cephalotes*, etc.) at the base of the garden. These had doubtless been brought in for a framework on tentative substrate. I recorded a similar case in *Cyphomyrmex costatus* in Panama (Rev. Ent. 12: 106, 1941)

and several instances of occasional use are recorded in this present paper. The pendant garden was 15 mm high \times 35 mm diameter; the color was yellow-brown internally and there were distinct bromatia. The ants also were exactly the color of the surrounding rotted wood and "feigned death" readily, as usual.

Cyphomyrmex bigibbosus ssp. *faunulus*
Wheeler (Plates 2, 8)

Ark. For. Zool., 17: 44, 1925.

The subspecies *faunulus* was described from Kartabo and Camaria, B. G. "The specimens belonged to small colonies which were nesting in cavities in rotten logs. The fungus gardens consisted of particles of insect excrement covered with a delicate white mycelium and resembled the gardens of *Myrmicocrypta squamosa* and of small species of *Apterostigma*, e. g. *mayri*, which live in the same situations."

This form was rediscovered by myself across the Cuyuni River from Kartabo at the Forest Settlement, Mazaruni River August 20 and 25, 1935, 22½ miles west of Kartabo by trail between the Cuyuni and Mazaruni Rivers September 8, 1935, and along the Oko River nearby, June 20, 1936. The latter record, from an *Atta cephalotes* mound containing a large fruiting fungus (*Lentinus atticolus*), was previously published (Rev. Ent. 8: 210, 1938). The *Cyphomyrmex* had a fungus garden above that of the *Atta* in clay and at a depth of 25 mm. The garden had typical spherical, white bromatia and a vegetal substrate including woody fibers, the thorax of a minima *Cephalotes atratus*, and part of a cryptocerine gaster. It was attached on all sides to the clay walls of a chamber 38 mm high and was not suspended from above. The ant skeletons had mycelial growth on them. Three females were taken. Larvae and pupae were covered with mycelium. A minute white millipede was found in the garden.

The September 8 collection was from the top of a white sand ridge at an elevation of about 350 feet above sea level.

An August 20 colony was nesting in swamp rain forest and among a tangle of epiphytic roots growing at one side of the upper surface of a fallen log at a height of one meter (Plates 2, 8). The nest site obtained small patches of sunlight during the morning but was otherwise completely shaded. The fungus garden, about 30 mm high \times 70 \times 25 mm, was attached to roots and was friable, crumbling easily. It had cells about 2-3 mm

in diameter and was gray externally, brown internally. The substrate appeared to be seeds and vegetal debris. The distinct bromatia (appearing a white and compact mycelial growth under a 20 \times hand lens) were best developed on the internal portions of the garden and were in consistency transitional between those of higher Attini, as *Trachymyrmex*, and those of *Cyphomyrmex rimosus*. Two types of myrmecophiles were in the nest. The ants were slow moving as in *rimosus*. The colony was gathered and placed in an observation nest.

The next day the ants were given small portions of the following pure, dried chemicals: blood fibrin, peptone, gelatin and dextrin. They were untouched over the following three days. Four workers were isolated August 21 and starved until August 24, two remaining alive. A few bromatia from a *Cyphomyrmex rimosus* colony were then placed in front of one worker. The ant walked by, completely ignoring them. A piece of the garden of a *Trachymyrmex cornetzi* colony was then given it. The ant extended the antennae, sidled half ways around it with antennae directed towards it but did not taste. The ant left; a few minutes both happened to walk towards it, one giving it an exploratory touch with the antennae but neither tasted the fungus. A crushed mosquito I had just killed on me was placed in front of one ant. It immediately started licking the carcass, then tore away protruding parts (legs, etc.), the better to get at the juices. The other worker also fed on the mosquito. The colony was divided into two and the parts kept separately. One was given farine August 24 and the other dried pure chemicals: hemoglobin, egg albumen, diastase and maltose. The farine was soon gathered for substrate but the chemicals were ignored during the following hour. The farine was generally well licked, then imbedded in the garden. Masses which had been imbedded would be repeatedly taken up, cut into smaller pieces, licked carefully while rotated between the fore legs and mandibles, then placed in a new situation. The part of the colony with farine had a myrmecophile of the squat, light buff Thysanuran type common in ant and termite nests. The insect would skirt the periphery of the garden at the base, furtively darting in to sieze a bit of the fungus garden. Once it crawled on top of the garden and, as it started down to the soil, encountered a worker. The ant immediately darted at the insect with mandibles outspread but the myrmecophile quickly escaped. By August 25 the chemicals had liquefied except the hemoglobin and were removed; the farine in the other

nest had all been used as substrate. A few amber fecal droplets were on the latter. September 4 the farine colony was given maltose, peptose, diastase, dextrin, gelatin, egg albumen and blood fibrin but the ants did not use any. By the next day a pest *Solenopsis* had so completely overrun the nest as to ruin it. The pests swarmed over the garden and prevented the *Cyphomyrmex* from feeding. The colony had to be ended. The other portion was preserved September 8 and by this time had white, compact bromatia in several places. The garden, gray externally, resembled that of higher Attini and was unlike that of *C. rimosus*.

Cyphomyrmex bigibbosus ssp. *tumulus* Weber

Rev. Ent., 9: 185, 1938.

The type colonies were taken August 25-26, September 2, 1935 from the vicinity of the Forest Settlement, Mazaruni River, B. G. Metatypes were taken July 22, 1936 along the Oronoque River in the far interior. The Forest Settlement colonies occurred in high mixed rain forest and in a magnificent stand of greenheart; the Oronoque ants occurred in high rain forest of a third type which included Brazil nut (*Bertholettia*), a nearby tree of Brazil nut measuring 6.7 meters in circumference at a height of two meters.

The nests were found in rotted wood and each contained a single fungus garden which was variably attached, resting always on the floor but variably pendant or attached at the sides. One was 53 cm above the ground in a neat cell in the side of a log, the garden being 30×80 mm. The ants had cleaned out a neat cavity in the humus and rotted wood lodged under the outer layers of the log. The situation was continually wet, with a relative humidity close to 100% at all times of the day or year according to the Government Forester, Mr. T. A. W. Davis. It was, however, well drained. The garden was covered with a gray mycelium and internally was yellow-brown. It was studded with compact, white bromatia. On the outside were round to elliptical cells 2-3 mm in diameter with septa 1-2 mm thick. There were many males present which did not attempt flight. The nest was collected and six days later, when preserved, the general shape of the garden was still retained. The bromatia were much reduced in number and confined to one area; the ants had been given no food. Males appeared to feed directly on the bromatia and on the mycelium. Larvae and pupae were

covered with the mycelium. Fecal droplets were present on the garden, which was attached to the glass ceiling in several places.

Another garden was suspended in a cell 50×45 mm inside a central fissure of a log. Part was damaged, the remainder being 32×25 mm, fragile and honeycombed. 30 cm away was another nest of this species and 30 cm still farther was a colony of *Apterostigma demerarae*. 10 cm away was a populous colony of *Neoponera apicalis*. The nest was collected and placed in a container. Two weeks later the ants were found to have maintained a luxuriant garden 24×12 mm. A male with crumpled wings was on it, as was a nearby shiny, clean egg and one covered with mycelium. Other eggs were visible, variably covered with mycelium. A number of tiny, pale droplets, probably fecal, were present on the garden. The substrate consisted of yellow to brown small particles. Bromatia were numerous but not as compact as in a *faunulus* colony. The garden had small, irregular cells.

The nearby nest was in a cell 60×25×25 mm high and contained a garden attached on all sides to the walls. Many males were present in the garden August 25. The nest was placed in a container and when preserved September 1 was found to have a minute *Prionopelta punctulata* which might have been preying on the *Cyphomyrmex*. The garden had been grown mostly on yellow, woody fragments and was pale yellow internally, gray externally. There were somewhat over a score of workers and an alate female. In the portion preserved were 25 workers, one alate female, 9 female pupae and several larvae. The pupae were 2.8 mm. in straight-line length and were totally white to slightly brownish with black eyes and sclerotized mandibular teeth; they had dark gray wing pads. The plump larvae were 1.6-2.0 mm. long and appeared to have long, simple hairs only about the mouth. These would doubtless serve a useful purpose in holding the fungus. A *Dolichoderus* head had been used as substrate.

A dealate female found with one worker in a tiny fungus garden and two workers found wandering nearby suggests a possible method of colony formation. The workers appeared to be full size and unlike the first brood of a queen founding her colony independently. The ants may have split off from the parent colony and started a new colony in this method. Such a situation would accelerate the rate of production of new colonies over the slower method of developing a first brood from eggs. The garden

was only about 10 mm long and a couple of millimeters wide. It was sessile except for two slight chains of garden suspended from the ceiling in a shallow cavity in the rotted wood. The nest was collected August 26 and by September 2 the ants had developed a garden 12 mm long by three millimeters wide. It was mostly suspended from a small twig but also attached to debris at the sides and bottom. There were a number of well developed bromatia which were compact and white mycelial aggregations. The substrate was heterogeneous, partly consisting of yellow, woody fragments.

A dealate female was taken with her garden July 26, 1936 near the Oronoque River. She occupied a cell which was roughly an isosceles triangle $20 \times 12 \times 9$ mm. beneath bark in rotted wood on the upper surface of a fallen tree. In the center of the triangle was the fungus garden which was $6 \times 7 \times 9$ mm. and suspended from the bark. The garden was grayish brown in appearance and without bromatia but having a scanty mycelium. The substrate consisted of miscellaneous pellets yellowish- to dark-brown in color. The garden had a hollow center and no brood was seen. The ant and garden were placed in a vial and lived successfully while I carried them from the interior of the colony to the coast and on a steamer to the United States. They survived the long railroad ride to North Dakota but were dead September 3, probably from the numerous and sudden temperature changes. While in the vial farine had been accepted for substrate.

67 mm. from this cell, also under bark and on the same plane, was a colony of *Cyphomyrmex rimosus trinitatis*.

Mycocephurus

Mycocephurus smithi Forel

Trans. Ent. Soc. Lond., p. 370, 1894, worker.

The genus *Mycocephurus* has not hitherto been recorded from British Guiana. The species *smithi* was described from St. Vincent in the West Indies and occurs locally in the whole Caribbean region. On July 9, 1936 I took specimens of this species on both the Surinam and the British Guiana sides of the Courantyne River. The Surinam workers were taken at the Indian village of Apura, several miles above the Dutch Mission of Washaba. The ants had numerous small crater nests in yellow clayey soil, the usual habitat and nest appearance I have found this species to have from Cuba to Trinidad. The British Guiana

worker was taken a few miles upstream from Apura. It was building a small crater nest with one or two openings on the white sand forest floor in heavy rain forest. Curiously enough this worker was paler and less coarsely sculptured than the other specimens or when compared with West Indian workers. Whether it represents a subspecies is difficult to determine without additional material. These Courantyne localities are in the vicinity of Latitude 5°N. on the lower part of the river and West Indian sailing vessels have been coming up the river a little or anchoring at the mouth for trade for several centuries. This commerce offers possibilities for migration of ants since soil is often transported with produce.

Myrmicocrypta

Myrmicocrypta elisabethae Weber

Rev. Ent., 7: 383, 1937, female.

The type locality of *M. elisabethae* is the vicinity of the Forest Settlement, Mazaruni River, B. G. and the species is known from the single female taken September 5, 1935. The ant was taken in heavy rain forest in a swampy depression. It has not been recognized since.

Myrmicocrypta guianensis Weber

Rev. Ent., 7: 385, 1937, worker, female.

A female and four workers, part of a very small colony, are the types of this species. They were taken July 24, 1936 near the Oronoque River in the far interior of British Guiana in high rain forest. The nest was 460 cm. from an incipient nest of *Atta sexdens* which it closely resembled. Externally there was a crater 80 mm. in diameter on which was a turret 18 mm. high and 35 mm. in diameter, expanded apically. The entrance was 8 mm. in diameter and turret and crater together were about 50 mm. high. At a depth of 110 mm. and slightly to one side was the sessile fungus garden, about 15 mm. in diameter. The garden was of pale substrate with thin mycelia lacking bromatia. Pupae were naked but the larvae had tufts of mycelia on their integument.

Myrmicocrypta squamosa v. *uncinata* Mayr

Verh. Zool. Bot. Ges. Wien, 37:554, 1887, worker.

Specimens in the Museum of Comparative Zoology, Harvard were placed as this form by Dr. W. M. Wheeler. In 1925 he referred to *squamosa* ants having gardens like those of *Cyphomyrmex faunulus* and *Apterostigma mayri*. They were collected by him at Kartabo. Until the type specimens of *uncinata* can be examined this record may be left as above. The holotype came from Sta. Catharina, Brazil.

The worker has three large and distinct pairs of spines on the pro-mesonotum in addition to two median and two lateral tubercles near the anterior pronotal border; the epinotal spines are distinct. The female has moderately high, very thick and subvertical frontal carinae; the two median and two lateral tubercles near the anterior pronotal border are more massive than in the worker; epinotal spines are thin but distinct; petiolar node a little longer than broad, concave behind; postpetiole $2\frac{1}{4}$ times broader than petiole, trapezoidal with rounded posterior angles and medially emarginate behind; the size is large and the color dark gray.

Myrmicocrypta spinosa Weber

Rev. Ent., 7:382, 1937, worker, female.

The type ants came from two nests in the same rotted log and were taken September 8, 1935 in swamp rain forest $22\frac{1}{2}$ miles west by trail from Kartabo Point, B. G. The log was inclined and supported by adjacent trees. One nest was at a height of 165 cm. the other 240 cm. above the ground and more than a meter away. It is possible that they represented one colony or that they came originally from one colony by a splitting or subsequent dissemination flight from the parent colony. The log also contained the type colony of *Apterostigma amiae*.

Both nests contained exceedingly fragile fungus gardens only loosely held together by mycelia. No bromatia were apparent and the substrate was in the form of small, spherical dark particles, probably from wood-boring insects. The gardens were a light, mottled yellow in color inside, grayish externally, with a coarse salt and pepper effect of the mycelium and substrate. One garden was suspended on roots but mostly resting on humus and was about 11 cm. high and 8 cm. in diameter, in a mass of humus lodged between the lower side of the log and the fork

of a mimosid tree. Rain would not fall directly on the humus but the relative humidity would nearly always approach 100%. The other garden was at the end of the fractured log where an overhanging piece of wood formed a roof while other pieces formed the bottom and one side. The garden was completely exposed to the damp air. It was 18 cm. long, 5 cm. deep and 3.8 to 6.5 cm. high, being partly attached to epiphytic roots but mostly sessile on rotted wood.

Additional workers were taken in the vicinity of the above nests on the same day but on the surface of a white sand ridge about 350 feet above sea level forming a low watershed. The dealate female which appears to be conspecific was taken August 20, 1935, also in swamp rain forest, but some 25 miles away near the Forest Settlement, Mazaruni River, B. G. It was wandering over the top of a rotted log as was a *Cyphomyrmex rimosus* female. The *spinosa* female was kept in a container with a small piece of the garden of a nearby *Cyphomyrmex bigibbosus faunulus* colony but was preserved September 8, after failing to develop this garden or one of her own.

Myrmicocrypta unidentata Weber

Rev. Ent., 7:384, 1937, worker.

The holotype of *unidentata* was taken August 23, 1935 in virgin greenheart forest about four miles from the Forest Settlement, Mazaruni River, British Guiana. The ant was at the base of a magnificent tree among the decayed leaves. Part of a colony was found June 19, 1936 about 40 miles away, being about 37 miles by trail from Kartabo Point near the Oko River, Cuyuni tributary. The ants were at the base of a tree and had a fungus garden about 2.5 cm. in diameter in clay just below a thin layer of humus on the forest floor. The garden was grayish in color and looked much like the dull buff clay. The ants were very timid.

Myrmicocrypta infuscata, sp. nov.

Worker. — Length 3.4 mm., of thorax 1.17 mm. Head in front view, excluding mandibles, $1\frac{1}{5}$ longer than broad, sides convex, occipital margin broadly concave, the angles terminating as blunt tubercles, anterior clypeal margin convex; eyes 0.09 mm. in diameter, protuberant, situated closer to the occipital than the clypeal margin; mandibles narrowly triangular, 9 teeth visible when mandibles are closed, others hidden beneath the clypeus; posterior clypeal margin produced as two teeth; frontal lobes small and rounded, carinae distinct and posteriorly expanded

to nearly enclose a circular area from which two smaller, lateral areas are similarly demarcated by carinae and terminate at the occipital margin in two medial tubercles, eyes small and hemispherical, situated closer to the occipital than the anterior clypeal margin; antennal scapes exceeding occipital angles by more than their distal diameters, funicular joints 2 and 6-7 nearly as broad as long, other joints longer. Thorax with two prominent medial pronotal denticles and two lateral pronotal denticles lower down and broader; posterior to these four are the usual dorsal pronotal tubercles which are the most massive of the thorax and are fully as broad as long; these protrude mostly laterally, the space between being flat; the mesonotal tubercles are more mesial and also large and conspicuous but lower than the preceding; on the declivous surface of the mesonotum are two distinct denticles larger than those on the pronotum anteriorly; in front of the meso-epinotal impression on the declivous surface is a bi-denticulate gibbosity on each side separated from the higher part of the mesonotum by a smooth concavity; meso-epinotal impression deep and rounded; epinotum marginate on each side, terminating as an angularity anteriorly and as long, acute teeth posteriorly. Petiole pedunculate, the node rising sharply; node from above rectangular, slightly longer than broad, anterior corners rounded and sides slightly convex, half as broad as postpetiole. Postpetiole from above slightly broader than long, trapezoidal with rounded anterior margin and slightly convex sides, emarginate behind, broader behind than before. Gaster truncate anteriorly with obtusely angulate corners; 1st gastric segment from above as broad as long.

Opaque finely and densely granulose, mandibles punctate-striate, sub-lucid. Pilosity of abundant squamate hairs which are a sordid yellowish white; these cap the ridges and tubercles. Dark ferruginous, head darkest and thorax next in density of coloring.

Holotype: one worker which I took August, 1935 in the vicinity of the Forest Settlement, Mazaruni River, B. G.

Resembling *M. occipitalis* of Bolivia in sharpness of sculpture but much larger and darker, and with a more elongate postpetiole. Close to *M. spinosa*, found in the same part of British Guiana, but slightly larger and distinctly darker. The eyes are 0.09 mm. in diameter compared with 0.08 in *spinosa*, the scape 0.9 mm. long compared with 0.8 mm., the postpetiole 0.31 mm. long \times 0.33 mm. wide compared with 0.28×0.31 mm. The thoraces of both are 1.2 mm. long.

Apterostigma

Apterostigma amiae Weber

Rev. Ent., 7:391, 1937, worker.

The type colony of *amiae* was taken September 8, 1935 between the Cuyuni and Mazaruni Rivers $22\frac{1}{2}$ miles west of Kartabo Point, B. G. The habitat was swamp rain forest and the ants were from the same inclined rotted log near a stream that contained the type nests of *Myrmicocrypta spinosa*. The ants were nesting in a rotted knot of the tree at a height of



Cyphomyrmex bigibbosus, fungus garden under bark on log. Steel tape ruled half-millimeters. Oronoque River.



Cyphomyrmex bigibbosus faunulus, site of nest among epiphyte rootlets on fallen log. Forceps 113 mm. long. The fungus garden has been scattered and is difficult to see in the photo. Forest Settlement.

one meter (not six feet as before stated) above the ground. The fungus garden was completely enclosed in a silken envelope of mycelium which was attached to the wood. The fungus garden had aggregations of mycelia approaching in appearance the bromatia of higher Attini.

Apterostigma auriculatum v. *demerarae*
Wheeler (Plate 8)

Ark. För Zool. 17:51, 1925, worker, female.

The typical *auriculatum* was described from Trinidad and the new variety from Kartabo, British Guiana. The worker and female of the latter were described as smaller, darker and rougher than the former. The ants "were inhabiting small fungus-gardens, a few inches in diameter, in cavities of rotten logs in the second-growth jungle."

Ants of a colony (Plate 8) which I collected at the edge of a clearing two miles back of the Forest Settlement, Mazaruni River, August 25, 1935 may be considered practically topotypes and were compared with the cotypes. Unfortunately the nest was damaged in discovering it. The fungus appeared to be more a crumbly mass as in *Trachymyrmex ruthae* than the pellet form in *Apterostigma urichi*. Close by (30 and 57 cm. respectively) were two nests of *Cyphomyrmex bigibbosus tumulus* and one of a ponerine. Phorid flies were hovering over all four, without, however, appearing to oviposit on the ants. They scurried over the debris of the nests. The *Apterostigma*s were customarily timid and feigned death upon my slightest movement. The fungus garden was resting in damp humus in a fissure between upper and lower parts of a log in moderate shade. Fire had run through here several years ago and modified the forest somewhat.

The nest was gathered and placed in a container. By September 1 the ants had built up an average looking *Apterostigma* garden consisting of coarse pellets and fragments of substrate covered by a grayish mycelium. There were no bromatia. On September 4 the nest was given pieces of pure chemicals: maltose, peptose, diastase, dextrin, gelatin, egg albumin and blood fibrin. These were untouched in the following hour. Six hours later the chemicals remained untouched except that a pest *Solenopsis* had been removing the maltose and feeding on the diastase. The latter ants took possession by 6:30 the next morning and drove the *Apterostigma*s to one side.

They even crawled over the latter, who feigned death. The colony was then preserved.

Apterostigma dorotheae Weber

Rev. Ent., 7:389, 1937, worker.

One of the small species without strong sculpturing is *dorotheae*, described from the vicinity of the Oronoque River in the far interior. A colony was found nesting 11 cm. below that of a very unlike species, *epinotale*, both in the mass of humus in the rotted buttress of a stump in high, virgin rain forest. Both gardens were pendant on roots and were also attached at the sides. There was no evidence of a mycelial envelope around either though both were damaged in discovering them accidentally. The garden of *dorotheae* was larger and was uniformly dark gray. The mycelium was diffuse and without bromatia.

Apterostigma epinotale Weber

Rev. Ent., 7:390, 1937, worker.

The sole species known in this large genus with distinct epinotal spines is *epinotale*, from the far interior of the colony. The close association of the type nest with that of *A. dorotheae* is described above. The damaged garden was about $20 \times 15 \times 5$ mm. The substrate consisted of small pellets which were mostly brown to yellowish brown and was covered with a loose mycelium which lacked bromatia or other concentrations of fungus. The pellets appeared to be mostly of insect feces.

A second colony was taken in the same locality six days later in a fallen log, probably a Brazil nut. The fungus was $26 \times 21 \times 18$ mm. and was suspended from a root, enclosing the latter completely. The substrate was yellowish brown and was covered uniformly by a mycelium which lacked bromatia. Embedded in the substrate was an entire, minute weevil and there were tiny pieces of chitin. The nest was 41 cm. from one of *Trachymyrmex cornetzi* which in turn was 15 cm. from one of *Cyphomyrmex bigibbosus*, all in humus below a half imbedded rotted shell of a Brazil nut fruit which had lodged here. The micro-habitat was identical. The single female is described below.

Brood, which was very little, consisted of unpigmented pupae 3.9 mm long and plump larvae, one of which was 1.8 mm. long \times 1.25 mm. wide. The latter resembled the female larvae of *Atta cephalotes* in plump appearance and seemed

mostly smooth except for a cluster of hairs about the head and adjacent part of the middle of the body to which the head was folded. The hairs were simple, curved to somewhat hooked at the apex, tapering, and up to 0.23 mm. long.

The colonies of this aberrant species appear to number about a score or less of workers.

Dealate female (undescribed). — Extended length 5.7 mm.; of thorax 2.0 mm. Similar in angularity to the worker. Occipital region strongly constricted as a neck; eyes 0.20 mm. in diameter. Mesonotum with an irregular pair of carinae on the basal surface which terminate in short teeth posteriorly as in the worker. Petiolar node forming a sharp, obtuse angle anteriorly, slightly over half as wide as the postpetiole. Postpetiole from above hexagonal, longer than broad. First gastric segment entirely and sharply carinate on the sides. Abundantly pilose, the hairs long and irregularly curved. Dark brown, appendages paler.

Gynotype: One female (No. 608) taken July 28, 1936 by the Oronoque River, B. G., near the junction with the New River.

A single male taken in the vicinity of the cotype colonies July 21, 1936 (No. 581) appears to belong to this species because of its spinose epinotum, angular habitus and comparable size. It is 6.3 mm. in extended length with a thorax 2.4 mm. long. The eyes are 0.5 mm. in diameter, the mandibles triangular and edentulate, the antennae 13-jointed; the occipital region is prolonged as a neck which is deeply emarginate above and below. The pronotum and mesonotum anteriorly are both bluntly tuberculate. The unusually long epinotal spines are 0.47 mm in length from the general contour of the surface and are triangular basally, narrowed apically to blunt tips. The petiole in lateral view is smoothly and broadly convex without node but dorsally the nodal region is marked by a pair of irregular carinae which join anteriorly. The postpetiole resembles that of the female but is more rounded and broader than long. The gaster is sharply carinate on the sides. Wings infuscated, veins brown.

Coarsely sculptured; basally finely granulose; vermiculate generally to vermiculate — reticulate on the gaster, with long moderately abundant, curved hairs. Blackish brown, appendages dark brown.

Apterostigma jubatum Wheeler

Ark. För Zool., 17:47, worker, female.

Another ant with Kartabo as the type locality is *A. jubatum*. Numerous workers and a single female "were living in cavities in rotted logs in fungus-gardens a few inches in diameter."

Apterostigma mayri Forel (Plate 3, Fig. 1)

Ann. Ent. Soc. Belg., 37:604, 1893, worker.

Forel described *mayri* from Trinidad but it has since been found to be perhaps the most widespread species in the genus. The ants are small, dark, and without pronounced sculpturing.

The species is noted by Wheeler (1925, p. 54) as abundant at Kartabo and earlier (1916, p. 11) he recorded "several workers from Tukeit (Lutz)." My collections from the Forest Settlement, Mazaruni River, across the river from Kartabo, confirm Dr. Wheeler's statement. In August, 1935 they were found a number of times, both in swamp rain forest back of the settlement and in virgin greenheart forest about four miles north northwest. The species was taken in mixed rain forest along the Oko River, short tributary of the Mazaruni, 25.VI.36, in rain forest on gray clay along the Courantyne River at King William Falls, 15.VII.36 and in a different type of rain forest containing Brazil nut trees, along the Oronoque River, 22.VII.36 and 3.VIII.36.

Three colonies taken in greenheart forest lived under conditions of dense shade. The forest was a climax type and contained in addition to the greenheart such trees as *Swartzia schomburgkii*, *Aspidosperma excelsa*, *Burhinia* and the myrmecophyte, *Cordia nodosum*. One colony had a nest under a rotted log which was hardly larger than a peanut and friable. The log was moss covered and in a wet situation. Another colony nested under a piece of fallen wood on the southwest side of a giant rotted tree. During the day spots of sunlight fell here. The garden of one or two centimeters in diameter was enclosed in a thin and delicate silken envelope. Inside were many males which did not attempt flight when the nest was disturbed. It was placed in a small container on the day collected, August 26, and on September 1 the garden had only a scanty mycelial growth. The garden was of average appearance and had a substrate of miscellaneous small fragments of various colors. By September 4 the large population of adults for the small garden prevented much of a mycelial growth. Some hyphae appeared to be growing directly from a piece of brown rotted wood from which the garden was partly suspended at one side. Most of the substrate, however, did not appear to be woody. There were tiny amber fecal droplets on the garden. The workers "feigned death" by drawing up their legs close to the body so that the

"knees" were on a level with the highest part of the thorax. The antennal scapes were appressed to the head as much as possible with the funiculi directed to the apex of the mandibles. The males rested quietly and did not attempt flight when the nest was examined. In "feigning death" they took a position as in the worker but the antennae, being longer, were directed forward beyond the head. The colony was preserved on this date and consisted of 24 workers, 2 alate females and 15 males. No brood appeared to have survived.

The third colony nested in the empty half of a greenheart fruit which was $62 \times 51 \times 29$ mm. (Plate 3, Fig. 1). The fruit had sprouted at one time and used up all of the endosperm, hence leaving an elliptical cavity in which the ants had their garden. This had a substrate of the usual small particles liberally sprinkled with small amber fecal droplets. The garden also contained a number of eggs, several of which were covered with a mycelium.

A colony at King William Falls on the Courantyne nested under a decayed cocorite palm frond about 140 cm above the ground as it remained attached to the plant. The garden was 12 mm. in diameter and was light gray in color. The substrate, of miscellaneous origin, rested on the sides of the narrow space. No bromatia were evident and no silken envelope. The larvae were covered with mycelium. Another nest, perhaps of the same colony, was found in the gathering dusk of the evening, 90° around the palm trunk from the former nest. The nest was in a triangular space $90 \times 65 \times 35$ mm. with apex down, formed between the trunk and a frond. The garden consisted of course digitate processes which were pendant on epiphyte rootlets and grooved; these gave a superficial appearance of honeycomb-like cells. There was a delicate mycelial envelope which was easily destroyed. No bromatia were apparent but there were loose aggregations of hyphae. The substrate was of yellow, brown or black particles which imparted a green color to alcohol as if containing chlorophyll. There were the customary fecal droplets on the garden. Pupae in the garden were covered with mycelium. What may have been a third nest of the colony was found 20 mm. above the second. It contained only a few workers. In the gathering darkness at the night's camp there was no opportunity for further examination.

Apterostigma urichi Forel

Ann. Soc. Ent. Belg. 37:603, 1893, worker.

One of the largest and most attenuated species in the genus is *urichi*, originally described from Trinidad. Wheeler (1916) recorded a single worker from Kaietur, B. G. as a possible variety and the species from Kartabo (1925). At Kartabo it was found in "rotten logs in the second growth jungle." Dr. Wheeler gave me workers from Kartabo, No. 66, July, 14, 1920 and No. 508, Aug. 14, 1920 of this species.

In high rain forest back of the Forest Settlement, Mazaruni River, a few miles from Kartabo, this species was taken Aug. 16, 1935. The ants of a colony nested under a slab of wood from a fallen, half-rotted log. The garden was enclosed in a silken envelope of mycelium which was attached to the under surface of the wood and to twigs and leaves on the ground. The nest was collected and placed in a container for observation. There were 24 workers and 200 males. Larvae were embedded in the mycelium. Aug. 19, at 8 a.m., the ants were given blood fibrin, peptose, dextrin and albumen as an experiment to see whether they would use pure chemicals as substrate. By 9:45 a.m. they had removed some of the blood fibrin and dextrin. By Aug. 21 the peptose was gone except for a little which had soaked in, some of the blood fibrin and a little dextrin had been removed but the gelatin was untouched. At 3:40 p.m. they were given hemoglobin, egg albumen, diastase and maltose on separate squares of paper. At 3:45 a worker tasted the maltose, at 3:53 the same worker with another was feeding on the same food. At 3:55 four workers were feeding on maltose and one was tasting the diastase. At 4:05 four workers were still feeding on the maltose and by 5:15 nearly all of the latter was gone, several ants feeding on the remains. Aug. 24 the ants were given farine for substrate. 30 minutes later they were busily engaged in embedding the farine in the fungus garden. By the next morning all farine had been so incorporated, some of which had fluffy mycelium growing on the particles in the 16-hour interval. By Aug. 27 the fungus had developed well on the farine; some particles of the farine were yellowish in color, presumably from fecal droplets. The colony was preserved on this day and contained males and callows. The behavior of the ants throughout had been exactly like those of *urichi* in Trinidad.

A colony collected July 22, 1936 near the outlet of the

Oronoque River into the New River of the Courantyne system nested in high, virgin rain forest. In one rotted stump was a colony of *urichi* and a colony each of *A. dorotheae* and the aberrant *A. epinotale*, a remarkable occurrence. The three species differed markedly in morphology. The *urichi* nest was 45 cm. from that of *dorotheae* which itself was directly below that of *epinotale* but in the adjoining buttress. The fungus garden was about 120×80×60 mm. At the top of one part was a mat of mycelium resembling a portion of a mycelial envelope. A heavy mycelial coating on nearby rootlets suggested that it represented the beginning of a mycelial envelope or the collapse of an older one. The garden was attached at all sides and was gray in color. The ants "feigned death" as did those of *dorotheae* and *epinotale* but for shorter periods of time, whereupon they moved rapidly on their long, spindly legs.

Apterostigma urichi ssp. *guianense* Weber

Rev. Ent., 7:393, 1937, female.

A female with her tiny fungus garden forms the basis for this subspecies. The ant was taken July 20, 1936 near the outlet of the Oronoque River into the New River of the Courantyne system. She was in a small cavity in rotted bark of a living large tree at a height of 122 cm. above the ground. The garden was about 10 mm. long × 8 × 2 mm.

Apterostigma urichi ssp. *nitidum* Weber

Rev. Ent., 7:392, 1937, worker, male.

This subspecies was described largely because both the males and workers of a colony had a shining integument instead of the customary opaqueness. The colony was collected above the Orealla Indian Mission near Hepseba along the lower Courantyne River July 8, 1936. The ants nested in an old, red, rotted stump on a white sand ridge. Surrounding the nest in the wood were chambers of the termite *Subulitermes parvulus* (Silv.) (det. Dr. Emerson).

Before finding the nest I cut into the stump and exposed some empty fungal webs in pockets in the rotted wood. I mused at their resemblance to the fungus grown by *Apterostigma*. When one such web was pulled apart an amber droplet on the outside even more strongly suggested an attine fecal droplet. This web was hanging free and inside, at the base, between the collapsed

outer layers was a small gray amorphous mass. This mass was probably an ordinary mycelium of exceptionally luxuriant development growing on a particle of substrate. There were no ants inside. The above observations indicate that the mycelial envelope in *Apterostigma* may be a growth independent of the ants. Had the ants developed these webs around substrate, remains of the latter in the form of recognizable pellets would have been present. The weather within recent days had been very wet so that the log was saturated much of the time. This wetness coupled with what may have been an unusually nutritive substrate, *unattended by ants*, may have induced the formation of the mycelial webs.

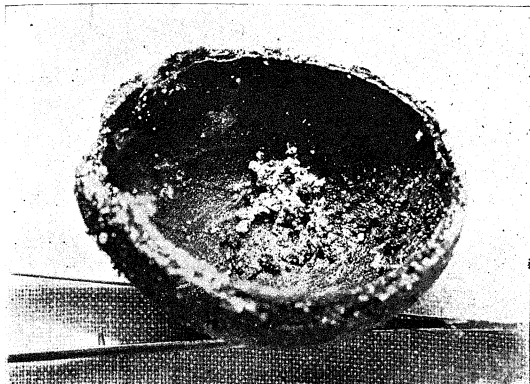
The nest of the ants was finally found. The fungus garden was enclosed in a mycelial envelope and on this were usually well developed bromatia. There were 29 workers and one male, other males may have escaped.

Sericomyrmex

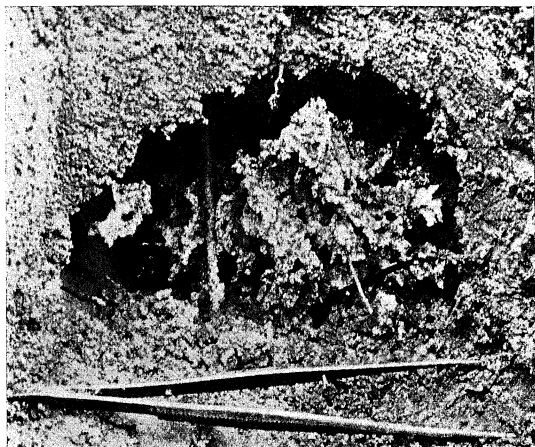
Sericomyrmex harekulli Weber

Rev. Ent., 7:398, 1937, worker.

The species is known only from the type locality, the Oronoque River in the far interior of British Guiana. The type colony had a crater entrance to its nest. A small tunnel led downward and to one side to the first chamber 8 cm. below. This chamber was 8 cm. high \times 15 cm. broad and elliptical in form. The fungus garden was pendant on numerous small roots. The female and much brood were here. 7 cm. below this chamber (not 5 cm. as previously stated) was a second one, also elliptical and 6 cm. high \times 10 cm. broad. The second garden was also pendant and both were gray externally, golden brown internally and developed on miscellaneous substrate. The fungus developed loose mycelial aggregations and moderately formed bromatia. Larvae and pupae had tufts of mycelia and a few minima larvae were on an unusually dense bed of mycelium, very thick, high and white. The adults feigned death readily but also tried to escape by running. Other colonies were seen in the vicinity and none had turrets.



Apterostigma mayri, fungus garden in husk of fallen greenheart fruit.
Forest Settlement.



Sericomyrmex harekulli arawakensis, fungus garden in sandy soil. Forceps 113 mm.
long. Forest Settlement.



Trachymyrmex phaleratus, nest in clay. Turret entrance to nest has a fallen twig resting on it. The single fungus garden appears below. Oko River.

Sericomyrmex harekulli ssp. *arawakensis* Weber
(Pl. 3, Fig. 2)

Rev. Ent., 7:399, 1937, worker, female.

The type locality of *arawakensis* is the Forest Settlement, Mazaruni River. The type colony, on August 16, 1935, had a nest with three chambers. The first was at a depth of 20 cm., elliptical in form, and 85 mm. high \times 95 mm. broad (Plate 3). The second was at a depth of 38 cm. and 15 cm. to one side of the first chamber. The third was 12 cm. beneath the second and 76 mm. to one side. All had pendant fungus gardens with roundish external cells having a diameter of 5-8 mm. and with septa 1-1.5 mm. thick. The nest was collected and placed in a crude observation nest.

August 19 the ants were given pure dried chemicals for substrate: dextrin, peptose, gelatin and blood fibrin. Within less than two hours the peptose liquefied and the ants had covered it with blood fibrin and gelatin. The remainder of the fibrin had been removed. By August 21 the gelatin had been nearly all removed as was the fibrin. The peptone had liquefied and the dextrin was gone except for some wetted in the paper. They were given additional dried chemicals: egg albumen, hemoglobin, diastase and maltose. For about two hours these were untouched. Later in the evening the ants were found to have taken practically all of the maltose and several ants were busily lapping up the remainder. By August 24 the ants had ignored the other chemicals and were then given farine. Within less than one and one-half hours the ants had removed all of the latter to their garden. August 29 the garden was found to be studded with eggs, some smooth and shining, others with mycelial tufts. Amber fecal droplets had also been deposited on the garden. They were given more farine.

The fungus was cultured artificially on a tube of potato-dextrose agar. August 17 a small tuft of mycelium was introduced. By August 29 a growth several millimeters high had developed. This was a white, cottony growth with a few loose aggregations of glistening, more globular structures exactly resembling the bromatia found in nature. In a tube of maltose agar which had been similarly inoculated August 22 similar bromatia were developing August 29.

September 4 the ants were again given dried chemicals: maltose, diastase, blood fibrin and hemoglobin. A little over an

hour later the ants had removed some of the fibrin. The garden contained dark brown fecal droplets as well as some much paler. Six hours later all of the maltose and fibrin had been removed; diastase had liquefied.

The colony was preserved September 8. At this time the garden was in flourishing condition with a good mycelial growth and many amber fecal droplets. There were no compact bromatia but the mycelium in some place was denser than in others. Hemoglobin crystals had been imbedded in the garden and were covered with hyphae. Larvae, in cells of the garden, were also so covered. The garden was partly pendant on a twig resting on the floor of the nest and sessile on pieces of paper. Part of the time the garden was also suspended from the glass ceiling. All of the refuse of the nest had been neatly gathered into one wet pile.

Workers were also taken along the Oko River, west of Kartabo Point, June 24-25, 1936. They were found about the rotted stump of a tree which contained a bivouac of *Eciton (Labidus) coecum* Latr. in which the rare queen was discovered (Weber, 1941, p. 327). Others were about the *Atta cephalotes* nest on which the sporophore of *Lentinus atticolus* was growing (Weber, 1938b).

Sericomyrmex impexus Wheeler

Ark. För Zool. 17:54, 1925, worker.

S. impexus was described from seven workers taken "in a sandy spot behind the tropical laboratory at Kartabo." There are no other published records. Workers were taken August 23 and 26, 1935 in virgin greenheart forest about four miles from the Forest Settlement, Mazaruni River. The ants were wandering on the ground at the bases of the magnificent trees. A colony taken June 22, 1936 in rain forest on a ridge near the Oko River, Cuyuni tributary, had a small, new crater entrance to the nest. At a depth of 77 mm a chamber 65 mm high by 72×35 mm lateral diameters was opened. The fungus garden was attached to roots and was dark gray externally, golden brown internally. The garden had better developed bromatia than in a *Trachymyrmex phaleratus* nest nearby. Larvae in the nest were naked. The ants "feigned death" as usual and may have had another chamber but time was lacking for more detailed observations. A worker was taken June 21, 1936, crawling in the excavations made in the *Atta cephalotes* nest on which the sporophore of *Lentinus*

atticolus was growing (Weber, 1938b). Workers of *Sericomyrmex harekulli arawakensis* were also taken at this site.

Two workers taken July 21 and August 1, 1936 along the Oronoque River in the far interior markedly extend the range. One was taken while crawling on the same large, prostrate log which contained a colony of *Cyphomyrmex bigibbosus*.

Sericomyrmex lutzi Wheeler

Bull. Amer. Mus. Nat. Hist., 35:9, 1916, worker, female, male.

Dr. H. E. Crampton and the late Dr. F. E. Lutz took the castes of this species in 1911 on one of the early expeditions to the far interior of British Guiana. The ants were taken from a "small island" of forest in the savannah near Kauwa Creek, Roraima. The species has not been recognized since.

Sericomyrmex myersi Weber

Rev. Ent., 7:400, 1937, worker.

The holotype was taken at King Frederick William IV Falls, Upper Courantyne River, on the Surinam side. At this site the forest is high and varied, typical of the magnificent forests of the Amazon-Orinoco regions. When I visited this site overnight, six months after the discoverer, the late Dr. Myers, the only conspicuous attine was *Atta sexdens*. There was a luxuriant ant fauna which could only be glimpsed in the short time, mostly after dark, which was available.

Sericomyrmex wheeleri Weber

Rev. Ent., 7:396, 1937, worker, female.

The Forest Settlement, Mazaruni River, is the type locality of *wheeleri*. The type colony was found on a clayey ridge in the rain forest slightly over two miles back of the settlement. The nest entrance was a mere irregular hole 50×70 mm in diameter and was partly bordered by a dead leaf whose margin had been cut away. The remainder of the entrance was formed by pieces of wood and leaves. A tunnel led at a slight angle (5°) from the vertical to an elliptical chamber at a depth of 90 mm which was 60 mm high ×130 mm broad. 20 mm below this chamber was a second which was 40 mm high ×60 mm broad. Immediately below was a third and larger chamber 45 mm high ×140 mm broad.

All three contained fungus gardens which were pendant on roots but also attached in places to the sides and floor. The third chamber contained a garden 55 mm in diameter which consequently occupied less than half the available diameter. The gardens had small and poorly developed bromatia and a heavy mycelial growth in places. The substrate was partly juicy and yellow, as if from some fruit, and partly brownish. The fungus growing over the yellow substrate appeared to be bright yellow in color. Brood was present in all gardens and the larvae were covered with a scanty mycelium. Three females were found. The workers were moderately sluggish and many in the gardens were covered with a whitish bloom. The prosternites of the workers had a glistening whitish bloom as in the type colony of *Trachymyrmex rufhae*.

240 mm from the nest entrance was the entrance to a young *Atta cephalotes* colony which had a single chamber at a depth of 70 mm and 25×35 mm in diameters.

Sericomyrmex wheeleri ssp. *pakeelai* Weber

Rev. Ent., 7:398, 1937, worker.

The virgin rain forest of the Oko River, Cuyuni tributary, is the type locality for *pakeelai*. The ants were nesting in clay soil on a steep slope and had formed a turret entrance to the nest which had a maximum height of 45 mm but had been washed down to nothing on the slope side by the heavy rains. The turret itself was on a mound 20 mm high and 120 mm in diameter which may have represented previous turrets which had also been washed down by rains. The turret was elliptical in cross section and 59×48 mm. The entrance was also elliptical and 9×22 mm, facing northwest. At a depth of 45 mm below the soil level was the first of six chambers. This was elliptical, 30 mm high ×38×18 mm, and contained a tiny garden hanging from a rootlet in the center. The garden was less than 10 mm long and 5 mm wide. 15 mm below the first was the second chamber, also elliptical and 30 mm high ×50×50 mm. It was filled with a garden suspended on roots and not touching either top or bottom. Brood was not found but may have been removed. 34 mm below the second was the third chamber, 70 mm high ×90×100 mm, containing garden and naked larvae. Below this and at a total depth of 300 mm was the fourth chamber, 60 mm high ×115 mm×110 mm, containing a small garden. At a total depth of 390 mm and below the fourth was the fifth chamber which

was similar to the one above. There were pupae here in the garden. A sixth chamber had been started below the fifth. All were largely in a direct line beneath the turret. The fungus gardens were gray externally, light brown internally and grown on a heterogeneous substrate which ranged in color from honey yellow to black. Some decayed wood or humus appeared to be included. Bromatia were not as compact as in *Atta* gardens. The fungus had fecal droplets.

Workers were also taken in the previous year (August 23, 1935) in virgin greenheart forest back of the Forest Settlement.

Trachymyrmex

Trachymyrmex abortivus Wheeler

Ark. För Zool. 17:40, 1925, worker.

This tiny ant (2 mm.) is known from a single worker taken by Dr. Wheeler at Kartabo Point "in a sandy area behind the Tropical Laboratory". He described it as allied to *humilis* and *irmgradae*. I have since described several small species belonging to the same group, including *schomburgki* from British Guiana. *T. abortivus* has not been recognized since and all of these small species appear to be rare.

Trachymyrmex cornetzi Forel (Plate 8)

Mém. Soc. Ent. Belg. 19:183, 1912, worker, female.

This species, hitherto unrecorded from British Guiana, was taken by me several times. It was originally described from Colombia from which several subspecies are known. Subspecies are known from Panama and Trinidad. Workers were taken along the trail from Kartabo Point inland 37 miles June 29, 1936 and back of the Forest Settlement, across the Mazaruni River from Kartabo, August 19, 1935. Others were taken between the Lucie River and King Frederick William Falls on the Surinam side of the Courantyne River July 16, 1936. They were in high, virgin rain forest on white sand, as near the Forest Settlement. A colony taken in high forest back of the Forest Settlement Aug. 18, 1935 had a nest in gray, sandy loam (Plate 8). At a depth of 23 cm. a chamber of about 6 cm. in diameter was unearthed. The fungus garden was friable and not suspended on roots. It was gray in color and broke up into irregular fragments easily. The larvae in the garden were largely clean except for a few hyphal pieces.

This colony was kept in an observation nest and by the

next morning some of the larvae had mycelial tufts on their integument. August 21 they were given small quantities of blood fibrin, peptone, gelatin and dextrin for substrate. At the end of the third day all had remained untouched. August 24 they were given dried hemoglobin, egg albumen, diastase and maltose. By the next day they were untouched but all except the hemoglobin had liquified from the humidity in the container. There were several pale amber fecal droplets on the fungus garden. August 27 the chemicals were removed and farine given for substrate. By the next morning most of the farine had been incorporated into the garden. All farine was moist and a pale buff in color as though the ants had defecated on the particles. Already a light mycelial growth had started on some. By September 1 the garden had become flourishing with well-developed loose aggregations of mycelia. Larvae as well as pupae were enveloped in the fungus. Fecal droplets were present on the garden. September 4 they were given all dried chemicals previously presented them and an hour later the ants were taking a little of the maltose to the garden. Five hours later a tiny pest *Solenopsis* in the container was removing the maltose rapidly but nothing else had been touched. Three workers were carefully licking a callosity which was just about able to walk. Other activities prevented care of the colony and by September 7 it was dead.

Trachymyrmex farinosus Emery

Bull. Soc. Ent. Ital., 26:221, 1894, worker.

The only record of this species from the colony is by Wheeler (1916) of a worker from Tukeit without other data. Emery gives the length of the worker as 4.5 mm. and the color as a dark ferruginous. It was described originally from Brazil.

Trachymyrmex guianensis Weber

Rev. Ent., 7:404-405, 1937, worker.

The holotype worker of *guianensis* was found on a small island in the New River, tributary of the Courantyne River in the southeastern corner of the colony, July 17, 1938. The island was covered with the same high, virgin rain forest that covered the general area and was located close to the outlet of the river. The ant was seen carrying a small object over leaves but this was lost in picking up the specimen.

Other workers were taken the next day, upstream in similar forest along the same river. They had small crater nests in the white, sandy soil. The craters had each a small entrance several millimeters in diameter. The ants carried sand grains from their excavating to one side where they built a comparatively high ridge. *T. trifurcatus* and *Atta sexdens* sens. str. occurred at this overnight camp also.

Trachymyrmex phaleratus Wheeler (Plate 4)

Ark. För Zool. 17:39, 1925, worker.

The type specimens of *phaleratus* were taken at Kartabo, British Guiana with the following data: "the nest was in clay, the entrance being a peculiar funnel-like structure about an inch in diameter and shaped somewhat like a human ear." The male was briefly described by myself in 1937 (Rev. Ent., 7:407).

A colony collected June 22, 1936 near the Oko River was 37 miles distant by trail from Kartabo but undoubtedly would be essentially the same as topotypes. It was in high virgin rain forest on a steep red clay slope. The entrance to the nest was similar to that of the type colony. It was a flattened turret with an upper rim 40×37 mm. which at its highest was 18 mm. above the ground and at its lowest 9 mm. (Plate 4). The diameter of the opening was 4 mm. At a depth of 46 mm. below the soil surface the chamber was encountered. It was 86×95 mm. in lateral diameters and 60 mm. high. The fungus garden, which was studded with amber fecal droplets, was grayish brown externally, golden brown internally. Externally it was honeycombed by cells 3-5 mm. in diameter. The fungus was in the form of loose aggregations of mycelia like primitive bromatia. The substrate was heterogeneous and yellow-brown to black in color. The garden was suspended from roots and was not attached to the smooth clay walls. The larvae were covered with a few hyphae. In a small tunnel at the base of the turret were male and female coccid-tending ants, *Acropyga (Rhizomyrma) paramaribensis* Borgmeier.

The male was in the same system of tunnels as the fungus-growers and in addition there was here a fierce-looking larva of another order. This was placed in a container with red clay. Within several hours it had tunnelled into the soil, its blunt head closing the opening and mandibles widespread, a good example of phragmosis. The insect may have preyed on the ants but there was no other evidence.

Another colony found June 25 in the same area as the above had a similar nest entrance. The nest was surmounted by a turret 60 mm. high which was 25 mm. in diameter and had an opening 5 mm. in diameter. In the soil at the base of the turret was a cavity about 7 mm. high \times 15 mm. in diameter in which was a tiny fungus garden containing one worker *Apterostigma mayri*. The garden contained no bromatia and looked as much like an *Apterostigma* garden as that of a *Trachymyrmex*. It was suspended from two small rootlets as two fragments, each five to seven mm. long and one or two mm. wide. There is a possibility that the *Apterostigma* had a nest contemporaneous with that of the *Trachymyrmex* but that it was in process of being abandoned because of the more flourishing condition of the neighbor. Beneath the superficial chamber was that clearly belonging to the *Trachymyrmex* colony and its turret. This was 58 mm. high, 80 mm. \times 80 mm. in lateral diameters. The fungus garden was completely pendant on roots and was gray in color externally, grayish brown internally. Many amber fecal droplets studded it as well as many very small bromatia of moderate development.

A colony found July 13, 1936 at Wonotobo Falls, Courantyne River extends the range to the eastern border of the colony. This also had a nest with a funnel-shaped turret entrance. The nest was in yellow clayey sand along the drogh line (portage) of three miles around the falls and was in high rain forest. The nest exactly resembled that of the Oko River nests.

Trachymyrmex phippsi Weber (Figs. 3-5)

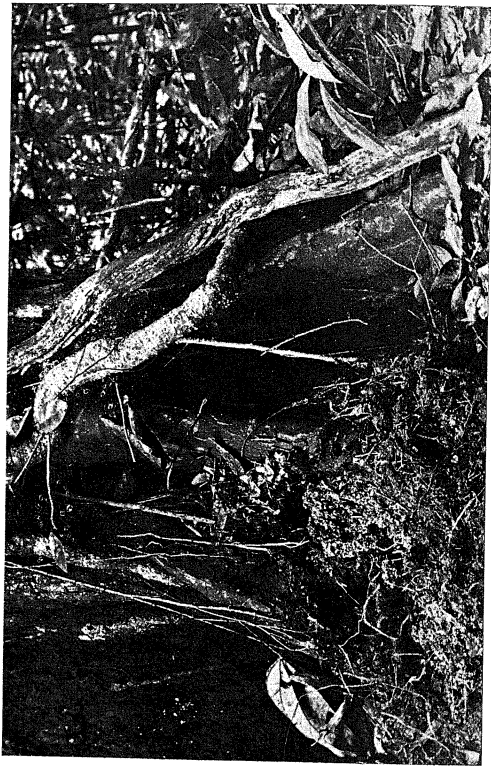
Rev. Ent., 7:405, 1937, worker, female, male.

The type colony (No. 613) was taken July 30, 1936 near the outlet of the Oronoqal River, Courantyne system. Workers and the queen from a colony (No. 607) from the same area are independently described as follows:

Worker. — Length extended 3.5-3.9 mm., of thorax 1.3 mm. Head in front view, excluding mandibles, slightly broader than long, broader behind eyes than in front; anterior clypeal margin sinuate, distinctly emarginate medially; sides convex with a small post-ocular tubercle; eyes about 0.16 mm. in diameter, moderately convex, situated closer to the anterior than to the posterior margin; posterior margin broadly concave, occipital corners rounded and with only small tubercles except for one large tubercle on the posterior margin which is directed backwards; frontal lobes projecting as rounded triangles, carinae well developed and diverging nearly to the occipital corners; pre-ocular carinae sharp, extending half ways over the scrobes; mandibles long and narrow with



Acromyrmex hystrix, multiple fungus gardens of a large nest in humus among aerial roots. About a score of gardens appeared in this view but are difficult to see in the photo. Oko River.



Acromyrmex hystrix, nest at base of large "counter" tree. The somewhat damaged fungus garden was loosely covered by debris and is exposed in the left foreground. Oko River.

feebly sinuate outer margins, a large apical tooth, a pre-apical tooth about half the size of the apical, and a series of small, irregular denticles; antennal scapes long and slender, exceeding the occipital corners by about 1/3 their length, all funicular joints distinctly longer than broad. Thorax above with three pair of strong tubercles or spines on the sides, the anterior pronotal being longest; pronotum anteriorly also with a median pair of tubercles of variable development but spaced apart; inferior angles of pronotum with a blunt flattened spine as in *Acromyrmex octospinosus*; declivous surface of mesonotum with a pair of small tubercles; basal surface of epinotum convex, anteriorly with a distinct pair of tubercles which may be compound, posteriorly with a pair of acute spines shorter and more slender than the anterior pronotal. Petiole over half as broad as the postpetiole, laterally with two pair of tubercles, above with a slender pair. Postpetiole broader than long, sides convex and with two or three pair of variably developed tubercles, anterior margin convex, dorsal surface with two rows of tubercles converging anteriorly, the posterior pair being large, coarse, compound and directed backwards. Gaster ovate, truncate anteriorly but without angular corners, coarsely tuberculate. Legs long and slender.

Opaque, granulose, moderately tuberculate, mandibles finely striate. Pilosity of short, hooked hairs, especially on the tubercles, and a short, appressed pubescence chiefly on the antennal funiculi so that the general integument under ordinary magnifications appears bare. Ferruginous, frons of head with an anterior and a posterior darker blotch, body largely concolorous.

Female (Dealate). — Length extended 6.2 mm., of thorax 2.1 mm. Similar to the worker except for the usual sexual differences. The antennal scapes are similarly long; the posterior occipital tubercle is the only large one of the head. Anterior pronotal spine large and triangular, directed laterally and forward; inferior pronotal spine, blunt, flattened and directed down and posteriorly. Epinotal spines somewhat smaller than the pronotal spines. Petiole over half as broad as the postpetiole. Postpetiole over 1½ times broader than long. Ferruginous with darker streaks and blotches, especially a nearly black spot on the ocellar area and a hastate blotch on the dorsal surface of the first gastric segment.

This distinctive species bears a curious resemblance to *Acromyrmex octospinosus* in general spinosity and in possessing a blunt, flattened inferior pronotal spine. It is allied to *T. urichi* but is distinctly smaller, paler and with different proportions of the various spines and tubercles. The similarity to *phaleratus* has been previously noted.

The nest of the type colony was 165 cm. above the ground in the rotted branch of a dead tree which had fallen into neighboring trees and remained in a reclining position. The fungus garden was suspended from the roof of a cavity and rested lightly on rotted wood and old carton of a termite nest at the sides and bottom. The garden was of irregular shape and extended tenuously 260 mm. into the hollow center of the tree but the bulk was about 60 mm. long × 6.4 mm. wide. The garden was noted at the time as having long cells as in *Acromyrmex*.

It lacked typical bromatia but did have loose aggregations of hyphae resembling the former. There were seven such aggregations on one side of the garden which appeared as whitish spots 2-3 mm. in diameter. Others were found in the cells and appeared to be luxuriant growths of largely straight hyphae. They probably had developed during the past few days of damp and overcast weather. On the garden were amber fecal droplets.

Brood in the garden included larvae with many tufts of hyphae on their integument and mature sexual forms. The proportion of males to females was unusually high, males outnumbering the females markedly. The workers endeavored to bite but were ineffectual. The nest was 130 mm. from that of an *Apterostigma* colony which was accidentally lost and thus cannot be identified specifically.

The nest of colony No. 607 occurred nearby also in high, virgin rain forest, and was 15 cm. from a nest of *Cyphomyrmex bigibbosus*. Both were in the rotted pieces of dark red wood from an old log lying on the ground which was falling apart. The garden was suspended from the wood ceiling and in a cavity obviously hollowed out by the ants. It was elliptical in form. 16 mm. high \times 21 \times 27 mm. There were well developed bromatia (Fig. 5). The garden strongly resembled that of the *Cyphomyrmex* but was more compact and with smaller cells. Both were gray in color outside, golden brown internally. The colony was youthful and the workers much more active than usual in *Trachymyrmex*. There were 17 workers, one queen, 10 workers pupae, mature larvae and semi-pupae, smaller larvae and eggs in the colony. A semi-pupa was 1.1 \times 2.3 mm. a medium-sized larva 0.6 \times 1.2 mm. (Figs. 3, 4) and an egg 0.34 \times 0.47 mm. All had heavy growths of mycelium, including the egg. The egg was whitish in color and broad-elliptical. 41 cm. along the same log was the type colony of *Apterostigma epinotale*.

Two additional females were taken nearby but independently of the two colonies. One was taken July 25 under a mass of humus on top of a rotted log. No fungus garden could be found. The other was taken July 29, also from a rotted log; the log contained nests of *Cyphomyrmex bigibbosus*. No fungus garden was found associated with either ant.

Trachymyrmex schomburgki Weber

Rev. Ent., 9:195, 1938, worker.

One of the rare, tiny species (2 mm) which make the group with a large postpetiole is *schomburgki*, described from a worker from the rain forest back of the Forest Settlement, Mazaruni River. Unfortunately it was collected with other ants in a pile of leaves on the forest floor and nothing further is known about it.

Trachymyrmex trifurcatus Weber

Rev. Ent., 9:199-200, 1938, worker.

The holotype worker of *trifurcatus* was taken along the trail leading eastward from the Oko River, tributary of the Cuyuni, June 29, 1936. The entire area was one of high virgin rain forest.

In the same year another worker was taken but on July 18 along the New River on the east side of the colony. The locality was above King Edward VII Falls and close to the Oronoque River which flows into the New River. The high virgin rain forest was of a different type from that along the Oko. Here also occurred *Atta sexdens* sens. str. and *Trachymyrmex guianensis*. Unfortunately in neither locality was there opportunity to study the ants since I was travelling rapidly through the areas in each case.

Trachymyrmex urichi Forel ssp. *fuscus* Emery

Bull. Soc. Ent. Ital. 26:222, 1894, worker.

Workers "from the savannah 10 miles west of Parmak and the Cotinga River, altitude about 3000 ft." were compared with cotypes by Wheeler (1916) and agreed closely but were "somewhat darker and covered with a whitish bloom." There are no other records but it is worthy of note that I also found *urichi* on the llanos of Venezuela near Ciudad Bolivar and on the Piarco Savannah in Trinidad.

Acromyrmex

Acromyrmex coronatus (Fabr.) ssp. *globoculis*
Forel

Rev. Suisse Zool., 24:429, 1916, worker.

Acromyrmex coronatus is a Fabrician species to which in the succeeding century and more many subspecies and varieties

have been attached. Most of these are from Brazil but the distribution also includes Costa Rica to Argentina. British Guiana is the type locality of *globoculis* but nothing on the habits has been published except an observation of mine in Wheeler (1937, p. 5). The female caste was described in 1937 (Rev. Ent., 7:408) from two females which I captured singly as they flew through the forest June 20, 1936 about 9 a.m., indicating a marriage or dispersal flight at this time. No rain had fallen previously this day and the day turned out to be the first day without at least one rain since March 5. From the preceding December 1 a continuous rainy season existed here except for about two weeks in February.

My records of the subspecies, the only ones available, are from two localities, the Forest Settlement, Mazaruni River, and the trail leading west from Kartabo Point to the Oko River, about 37 miles distant. An intelligent Arawak Indian at the former locality informed me that the Indian name for workers which I showed him was "Kuyamaru". The name may apply to *A. hystrix* and *octospinosus* as well. He gave this name to the ants at a nest as well as to minima workers shown him away from the nest. The ants occur in mixed rain forest as well as in virgin greenheart forest.

The nests were found above ground, under fallen logs or in masses of rotted wood and humus on the buttress roots of fallen logs, covered by a loose layer of dead leaf fragments. They contain numerous fungus gardens in separate cavities, more than five being exposed in one nest. In the latter nest the uppermost garden rested on coarse fragments of rotted wood and was 250 mm. long; another lower down was 480 mm. long \times 13 \times 10 mm. The gardens differed from those of *A. octospinosus* in being uniformly gray with only a suggestion of brownish tinge internally. They were studded with white bromatia. The gardens were suspended from the ceiling as well as sessile at the base.

The ants are vicious when the nest is disturbed and climb one's legs to bite. They are parasitized by phorid flies and two phorids were seen to oviposit on the back of the heads of two media ants in a postero-lateral location on the occiput. In an observation nest which had to be neglected the maxima workers were mostly dead in five days while the minima survived in a larger proportion. Some of the larvae and pupae were free of mycelium in this nest while others had a little. Ordinarily larvae and pupae are well swathed in mycelium.

Locally they may be of economic importance. At a temporary depot along the Kartabo-Okó trail I watched workers carrying away pieces of biscuit (soda crackers) from the thatch storehouse. The ants were active at 6 p.m. The man in charge said the ants were especially fond of split peas and rice. He was unable to stop their depredations since in that primitive area there was no way of constructing a tight warehouse from the materials at hand in the forest.

Acromyrmex hystrix Latreille (Plates 5, 6)

Hist. Nat. Fourmis, p. 230, 1802.

Workers under the synonym *emilii* Forel were recorded by Wheeler (1916) from Kaietur and Amatuk. In the mosaic book of 1937 he also listed Kartabo and my Forest Settlement and Okó River records. Plate I of the book is from my photograph of an Okó nest (see below) (Plate 5).

This species, in both Venezuelan and British Guiana, nests commonly above ground in debris piled on prostrate trees or among aerial roots. It is a rain forest species and nests above ground are always in places where the relative humidity remains high at all seasons. The mass of vegetal debris covering the gardens further protects the delicate fungus from drying out.

The nest previously figured (Plate 5) was formed in a mass of aerial roots like a broom extending from a tree. Humus and vegetal debris from decomposing leaves and twigs had accumulated here and had doubtless been increased through the activity of the ants. The dimensions of the mass were 174 cm. high \times 150 cm. broad \times 75 cm. maximum depth and probably about $\frac{1}{4}$ of the bulk was made up of fungus gardens, a considerable mass for a fungus-growing ant (except in *Atta*). A score of gardens about the size of grapefruit were visible at one time and the total of the gardens was several score. The gardens were bluish gray externally, golden brown internally. A peculiarity of the nest was a covered runway of carton which had been constructed around the trunk of a sapling growing from the middle of the mass. Similar carton occurred elsewhere within and without the nest. The carton varied in composition from purely vegetal to humus material. It may have protected the ants from rain as they moved from one place to another in the nest.

A nest was established on top of a large fallen log and at the base of an epiphyte. A portion of one of the numerous fungus gardens was placed in an observation nest with some of the ants

for two days until the container was needed for other purposes. The larvae in the garden were kept smooth and shining but the larger pupae were fairly well covered with mycelium. The workers appeared to rasp off the fungus projecting from angles of the pupa legs and from other angles. The bromatia and gardens were similar to those of *A. octospinosus* in Trinidad. A worker was watched as it picked up a bromatium. It rotated the piece between the legs and mandibles, rasping it with the mouthparts so that the entire bromatium disappeared down the mouth in a few seconds. The ant then pulled on a mycelial tuft and ate it also. It next picked up another bromatium and started to eat this when a much larger worker came and started to lap the fungus in typical regurgitation posture. The second ant then moved away with the fungus and entered a cell of the garden. Two other workers were seen to feed on the mycelium covering pupae.

One nest $22\frac{1}{2}$ miles west of Kartabo Point was at the base of a "counter" tree and at the east side (Plate 6). The gardens were attached to roots penetrating the nest and were also sessile.

Another species of *Acromyrmex*, *coronatus* ssp. *globoculis* Forel, occurs in the same regions and workers of the two may be found along the same path.

Acromyrmex octospinosus (Reich)

Mag. d. Thierr., 1:132, 1792.

Acromyrmex octospinosus pallidus, Crawley, Ann. Mag. Nat. Hist., 1921, (9) 7:92, worker (Issororo, B. G.).

The type species of the genus, which is so common in Trinidad and locally in Venezuela, has not often been encountered in British Guiana. Wheeler (1937) does not list any records of his own from the Kartabo region, where he collected many species of ants, but gives only Issororo (Bodkin) and my Oronoque River.

The Issororo specimens were apparently immature workers and were named a new record variety by Crawley. The type locality is Cayenne, French Guiana. I seem, however, to have collected it once at the Forest Settlement Sept. 5, 1935. Along the Courantyne River, on the Surinam side 15 miles or so above Wonotobo Falls July 13, 1936, I collected workers which I noted at the time as resembling *octospinosus* yet were definitely smaller. The largest workers in the colony were collected and, as the ants had a large fungus garden about 20 cm. in length,

it did not appear to be a young colony. The nest was in a rotted log 120 cm. above the ground. In the wood and humus surrounding the garden was a small *Nasutitermes*. Another Courantyne record, also on the Surinam side, was about 50 miles above Heseba, July 9, 1936 in a dense Mora forest. A single worker was carrying a leaf at the base of a Mora and was the only seen on an overnight camp. A male was taken along the Oronoque River in the far interior July 26, 1936. It was found hanging to a leaf 150 cm. above the ground and was the only *Acromyrmex* specimen found in this region.

For the biology of the species in Trinidad see the previous part of this series (Part VIII).

Acromyrmex (*Moellerius*) *balzani* Emery ssp.
myersi Weber

Rev. Ent., 7:408, 1937, worker.

Moellerius balzani and its subspecies are widely distributed in South America from Argentina north to Colombia and Venezuela. The present subspecies was described from the Southern Rupununi Savannahs, B. G. Unfortunately nothing is known about its habits but they may be inferred from those of the subspecies *planorum* which I took in nearby Venezuela. My photograph of the nest appeared in Wheeler (1937, Plate II, left) and shows two fungus gardens connected by a perpendicular gallery in sand beneath a clump of grass. The ants used sections of grass as substrate for a fragile and delicate garden. More than two gardens may be developed by a colony.

Atta

The well-known ants belonging to this genus are familiar to everyone in British Guiana and go by the names of "coushi", "cuschi", "cushy", "acushy" or "acuschi" ants. Three species occur in the colony and the ranges of two of them meet at the junction of the Cuyuni and Mazaruni Rivers. *Atta laevigata* appears to enter from the back door, so to speak, as a savannah species. *Atta cephalotes*, which is the common *Atta* of Central America, northern South America and Trinidad, is the species of the rain forests of the northwestern portion of the colony but extends to the mouth of the Courantyne River forming the eastern boundary. While travelling along nearly the entire Surinam border on a hurried journey I found only *Atta sexdens* and this

is the common *Atta* of the countries to the south and east. It extends northwest to the Cuyuni-Mazaruni junction but I did not find it some thirty miles west at the Oko River. One might thus say that *cephalotes* comes in from the north, *sexdens* from the south and *laevigata* from the west to meet in the central portion of British Guiana.

The ants are always regarded as pests in the colony and an example may be this quotation from F. A. Squire, the Department of Agriculture (1933): "Coushi ants, *Atta octospina* Reich, *Atta cephalotes*, L., *Atta fervens* Say. and *Atta laevigata* Smith all occur locally.* In the heavier soils of the coastal belts this pest is comparatively easily controlled with carbon bisulphide which is poured down the main shafts of the colony and confined to the nests by closing up all the entrances. A common local practice is to explode the gas in the soil. I cannot however recommend this. In the sandy soils of the interior however, where this insect is exceedingly numerous, there appears to be no effective measure, as the soil is too porous to hold gases. In an experiment carried out at Sandhills, Demerara River, cyanogas and acetylene gas were used as well as carbon bisulphide with no avail. Moreover the nests are not isolated or confined to circumscribed areas as in the coastal belts, but are spread out over the countryside — entire hills being undermined by the ants."

Martyn (1931) writes of them on the Berbice River savannahs. On this grassland "the most noticeable irregularities are the patches of thicker vegetation arising on the low mounds which are nests of the Coushi ant (*Atta* sp)... The vegetation upon them differs from that found on the ordinary savannah." He gives a description and names of the plants found here. The ant is probably *Atta laevigata*.

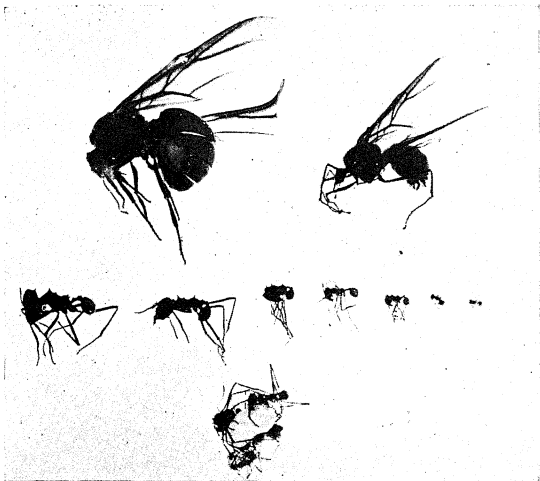
The most extensive early account of these ants is that by Schomburgk, based on his travels of 1840-4, and is quoted under *Atta cephalotes*.

Atta cephalotes L. (Plate 8)

Syst. Nat., 10th ed., p. 581, 1758, worker.

Linnaeus recorded *cephalotes* from "America meridionali" and refers to Surinam and Brazilian specimens. One of the earliest description of the habits of the species in British Guiana

*) *Atta octospina* is *Acromyrmex octospinosus*. *Atta fervens* Say does not occur in South America and this species is probably *Atta sexdens*. — N. A. W.



Atta sexdens, adult castes. Large female and smaller male above, worker castes beginning with soldier on next row. At the bottom several workers are grasping a sexual larva. Wonotobo Falls, Courantyne River.



Atta sexdens, site of nest on bluff overlooking junction of Cuyuni and Mazaruni Rivers. Two workmen were unsuccessful in reaching the fungus gardens.



Observation nests in Petri dishes: *Anterostigma auriculatum demercae* (upper right), *Cyphomyrmex bigibbosus faunulus* (upper left), *Trachymyrmex cornetzi* (lower left), *Alta cephalotes* queen with first brood (lower right). Forest Settlement.

is by Richard Schomburgk which is quoted below. For the remainder of the Nineteenth Century records appear to be lacking but probably occur in colonial publications. Wheeler (1916) refers to workers from Tumatumari and (1921) to workers defoliating *Tachigalia* near the Forest Settlement. Menozzi (1935) refers to workers from Canale and Baboocamp (= Babooncamp).

Specimens in my collection are from the following places:

Kaow I., Essequibo R., 3.IV.35, E. J. H. Berwick; Wanaina, N. W. Dist., V.35, J. G. Myers, Wauna and Tokomabu, N. W. Dist., 22.III.35, J. G. M. 4895, Waikarabi Crk., Barama R., 28-III-35, J. G. M. 5023, Essequibo R. above Panka, V.35, J. G. M. 5113, Cuyuwini R., Up. Essequibo, 15.XI.35, J. G. M. 5631; Kykoveral I., Essequibo R., 20.VIII.35, N. A. Weber 303, Forest Settlement, Mazaruni R., 16-29.VIII.35, N. A. W. 292, 311, 337-8, Hororabu, Mazaruni R., 14.VI.36, N. A. W. 469, Oko R., Cuyuni trib., 19-24, VI.36, N. A. W. 481, 483, 488, 493, 507, Village 63, Courantyne R., 5.VII.36, N. A. W. 542-543.

Credit for the first more than casual account of the habits of these ants in British Guiana should probably go to Richard Schomburgk who, through the assistance of Alexander von Humboldt, secured the support of King Frederick William IV of Prussia in investigating the natural resources of the colony in the years 1840-1844. His brother, Robert Schomburgk had explored this area in 1835-1839 under the sponsorship of Queen Victoria of England and the Royal Geographical Society of London. Earlier travellers, especially of ecclesiastical orders, traversed portions of this area intermittently following the discovery of the New World and must have observed these conspicuous ants.

W. E. Roth translated the two volume account of Richard Schomburgk and the two following quotations are taken from his translation. The first (1:185-186) refers undoubtedly to *Atta cephalotes* observed in what is now the Northwest District in an area draining to the Orinoco Delta. Schomburgk was visiting Fr. Cullen, who had a mission among the Indians here. The account follows:

"Were there not upon this hill an innumerable quantity of ants, and exactly of that kind, *Atta cephalotes* (Cushy-ant of the Colonists), which is particularly noxious to the Cassava plantations, I could have envied this gentleman his little Paradise. These terrible destroyers of the cassava and plantain fields have their dwellings underground and increase at such an enormous rate that their nests resemble huge mounds of thrown-up earth. A cassava or plantain cultivation in which they are nested soon resembles our timber areas after the caterpillars have devastated them. In a short while the ants eat away the whole of the leaves and drag them into their subterranean dwellings. If a field is once visited and robbed by them, the destruction of the whole is to be feared. Even when their nests are situate quarter of an hour distant they will find the

plantation and soon clear all the way up to it one of the most busily occupied paths imaginable. However sad it must be for the owner of a cassava field thus threatened by these pads, they proved extremely interesting for me and I devoted hours at a time in watching them. The track is about half a foot wide and somewhat depressed, but whether on account of the continual communication along it, or for some other reason, I am not in a position to determine: the rails of a railroad are hardly cleaner and smoother. With utmost military precision large numbers of the insects, ever on the move, march along it in double column, one towards, the other from, the field. In the latter column every single individual carries a piece of leaf the size of a three-penny bit, holding it erect in its mandibles, for which reason the Colonists also call it Umbrella ant: the other column is occupied by insects returning to the field. If the interval between the field and nest is too great, one notices another party coming to meet the tired carriers half-way and relieving them of their burdens which they now transport to headquarters, the others returning to the field. Although thousands are moving up and down not one insect steps in another's way, not one insect blocks the advance, or checks those which follow on in busy haste: everything runs as continuously and smoothly as clockwork. If the path is traced up to the site of destruction, one finds on it a third contingent consisting of the strongest and largest individuals that are restlessly engaged in biting the little round pieces out of the leaves and letting them fall on the ground where they are picked up by the busy carriers and conveyed away. Nothing neither fire nor water, nor any break in the pathway nor any other obstacle can prevail upon them to give up their work. Should thousands be killed by extreme violence, not a single corpse will be seen within a few hours; or directly the danger is over the dead bodies are removed. If the track be barred by some object which the feeble efforts of the ants fail to remove, they will soon get round it: if it be destroyed completely, one finds it re-established within a short while.

The ants themselves, especially the winged females, are deemed a delicacy by the Indians who bite off the abdomen which is eaten raw or roasted: it has indeed a pleasant sweet taste.

In these ant-mounds is usually to be found the *Coecilia annulata*, the "Two-headed Snake" as the Colonists call it, allied to the blindworms (*Lurthen*) which, according to what the Indians say, is fed by the ants like the *Claviger* by the beetles. I noticed for myself during my subsequent stay in the Morocco that the *Coecilia* is really a frequent resident in the nests and Fr. Cullen assured us that when he tried to destroy the troublesome insects by fires lighted over their mounds or by digging them out, he had come across numbers of the worm. Now whether the power of attraction depends upon the animal heat or particular atmosphere present in these mounds, or whether it is that the *Coecilia*, which always lives in the ground, only seeks the loose soil contained in them for the purpose of digging itself in with greater facility — the ants at any rate tolerate the worm, and the latter seeks for the ants and so both live together in brotherly concord. All Fr. Cullen's attempts to get rid of the nuisance had hitherto proved fruitless and his earnest wish to lay out a garden close to the Church remained impracticable: for what he planted to-day would to-morrow either disappear without a trace or be completely destroyed. Arsenic seems the only thing to exterminate them — but what amount would be necessary to destroy such millions?"

Schomburgk (2: 88) refers to winged Attas at the onset of the rainy season on the Rupununi Savannas. The

account may possibly refer to *Atta laevigata* instead of *cephalotes*. It is as follows:

"The winged males and females of the *Atta cephalotes* supply the greatest tit-bits. If here and there an isolated specimen of these large creatures lets itself be noticed on the wing the fortunate observer forthwith sounds the alarm through the village, and everyone that can run, rushes along with palm-fronds or other bushes, to the well-known hilly mounds in the forest which are now encircled by the women. The sharp tweezer-like mandibles, with which the females as well as male insects are provided, would scare any European, but not the Indians, for without bothering about their numerous bites the women seize in their already bleeding hands every one of the winged ants as they creep out of their tunnels. Should a specimen escape there are the boys standing by with their palm-leaf or bush ready to knock it down. Once caught the head is torn off and the abdomen, full of a mass of fat, then roasted or boiled: so prepared it is regarded as an even greater delicacy than the larva of the *Calandra palmarum*."

In the vicinity of the Forest Settlement several young nests were discovered (Plate 8). A very young colony containing only minima workers and the queen had a nest a depth of 70 mm. and contained a single chamber 25 mm. high and 35 mm. in diameter. Another nest nearby had a symmetrical chimney entrance 5 mm. in internal diameter and 30 mm. high on a crater with a diameter of 40 mm. At a depth of 65 mm. was the chamber which was elliptical in form, 75 mm. high \times 95 mm. diameter. The nest contained only minima workers and the queen. On the crater of the nest were found two species of red ponerine ants, *Ectatomma* (*Gnamptogenys*) spp. and nearby at the base of a tree a third but dark brown species of the same subgenus. Also on the crater was taken a worker *Cyphomyrmex rimosus trinitatis* and in the soil of the nest workers of the genus *Erebomyrma* with comparatively large eyes. 56 cm. from this nest was the entrance to a nest of *Sericomyrmex wheeleri*. A third but older nest was decidedly inconspicuous. Externally there appeared only a very small crater with a small opening through which a few minima workers were timidly pushing up sand after a recent heavy shower. At a depth of 15 cm. was an empty chamber which was doubtless the primary chamber excavated by the new queen. It was spherical and about 10 cm. in diameter. A large tunnel lead obliquely from this to a deeper chamber. The colony contained soldiers so that it had passed the early stage of its life history. A similar nest was excavated nearby. Both were in pure sand, white to gray in color.

An older nest at the edge of the clearing in second growth

forest had a well developed trail along a ridge. At a distance along the trail of 66 meters from the nest the ants were cutting *Montrichardia* leaves at 3-3:30 p.m. At a distance of 100 meters along the trail they were cutting leaves of a vine and had a short time before been cutting *Montrichardia*. At 108 meters they were cutting leaves of miscellaneous small herbs, *Montrichardia* and the small leaves of an *Acacia*. The small leaves or leaflets of the latter were severed at their bases by media workers who allowed them to drop to the ground where other ants carried them off. At 123 and at 132 meters they were cutting herbs. At 133 meters there was a small crater down which some ants brought leaves from the 123 and 132 meter sites. This may have represented a succursal nest.

The ants were nesting in clay. Nearby on a clay ridge passing through swamp ground another colony nested in an open site, while on higher ground a short distance away an *Atta sexdens* colony nested in gray sand.

The explanation of the somewhat feverish leaf-cutting activity probably was that the hour was overcast with sprinkles of rain.

Along the Oko River, a short tributary of the Cuyuni, this species was the only *Atta* found. The region was one of virgin rain forest. A gold miner told me (June 24, 1936) that when his party first established a camp here the previous December the "cushi" ants carried away much of their split pea and flour. When the party returned in March the ants had carried away about 40 pounds of the cache of split peas. The remainder had been pitted by other ants and had to be thrown away.

A young colony here had a small crater with an entrance 13 mm. in diameter. A tunnel led almost vertically down to a chamber at a depth of 75 mm. The chamber was almost spherical, being 67×62 mm. in diameter. It contained a fungus garden 58×46 mm. which had open cells varying from 7-10 mm. in diameter or even less. The garden was mostly bluish-gray in color externally and heavily sprinkled with bromatia. Part of the interior was brownish-gray, the remainder bluish-gray. The bottom of the chamber was littered with leaf segments. The colony contained no maxima workers or soldiers. The ants had been cutting leaves from nearby saplings.

A mature nest along the Oko extended diagonally down a slope for a distance of 13.5 meters and was in the middle four meters wide. To the nest extended a sunken runway diagonally

along the slope for a distance of 275 cm. The runway was 7-7.5 cm. deep, 10-15 cm. wide and was completely roofed over in many places by soil from a few centimeters to 21 cm. in length; it went under fallen wood in one place. The soil was reddish clay, probably siliceous laterite (see Davis and Richards, 1933-4).

A nest of moderate size was in the clearing about this new gold mining camp. It had numerous mounds about the common tannia plants but the ants were not harming these leaves.

A large nest has been previously described and illustrated (Weber, 1937a, 1938a). The clearing in the forest made indirectly by the ants was 11.5×13.8 meters and the soil beneath was honeycombed with the fungus gardens. The unusual feature was the growing of a large sporophore of a basidiomycete from an abandoned garden to which the name *Lentinus atticolus* was applied. The sporophore weighed 6 lbs. 6 oz. and had a pileus 47.8 cm. in diameter, standing 34.3 cm. high. Rhizomes from the sporophore were traced to the fungus garden. The fact that the ants did not eat fragments of the sporophore placed beside a nest entrance for 24 hours was interpreted by Stahel and Geijske to mean that it could not be the same fungus as that grown by the ants. This, however, could not be accepted as proof since the ants would not normally have contact with anything but the hyphae of the fungus and the "taste" of the sporophore might be very different. The fact that these ants will eat sporophores of other fungi, such as *Agaricus* and *Phallus*, does conversely not mean that these are the genera of ant fungi.

In this nest was taken a small nest of *Cyphomyrmex bigibbosus faunulus* and on the nest workers of *Sericomyrmex impexus* were gathering substrate (flowers, etc.). The termite, *Nasutitermes ephratae* (Holmgren) (det. Dr. Emerson) also had tunnels in the nest and a *Pheidole* colony foraged freely above on earthworms cut in excavating the nest. While so engaged a phorid fly was seen to walk over the clay to a *Pheidole* and attach itself to the piece of earthworm, riding for several millimeters and being ignored by the ant. The phorid appeared to be ovipositing. Another fly was captured by the ants.

Contributing to the appearance of this large sporophore (and a group of three 90-125 cm. distant which were of a different species and not associated with the ant nest) was the numerous and long-continued rains. A miner informed me that the rainy season started March 5 and June 20 was the first day

without rain. From December 1 to June 20 there was only a brief dry season of about 10 days in February.

At the native village of Hororaba, upstream along the Mazaruni a few miles from Kartabo Pt., these ants were an important pest. A large nest was at the edge of the clearing in the forest about 200 meters from the village. The ants had a low mound of customary shape and had several fungus gardens at depths of 25-50 cm. in the wet, sandy loam. They were dark gray externally and without a distinct brown interior. Only worker brood was found in these superficial gardens and there was no opportunity for further examination. There were many soldiers that attacked viciously. The ants had distinct paths radiating out to the village and through the surrounding forest. A photograph was taken of an Indian lady with many children standing beside her cultivated flowers. These plants were growing in miscellaneous old dishes which were placed on stilts whose legs rested in pans of water. The objective was to secure the plants from the depredations of the *Atta*. This objective was attained and as a by product mosquitoes bred freely in the pans.

Somewhat less than 20 meters distant from the nest was one of *Atta sexdens* sens. str. which was within the clearing (q. v.).

Downstream in the Mazaruni, on the island of Kykoveral, a huge colony of *cephalotes* dominated the entire tiny island. The colony had a large nest from which unusually broad runways radiated. Thousands of workers and soldiers were on these paths at 6 p.m. (Aug. 20), carrying parts of leaves and flowers. The soldiers worked equally with the workers in carrying these. Some of the plant sections had minima workers riding on them and being carried by the larger ants. At this time the ants were chiefly cutting hog plum (*Spondias lutea*) and mango leaves and flowers of Royal Palms. They were said never to touch avocado. Several phorid flies flew along the files in the direction of the nest, ovipositing on the ants.

At the village known as No. 63, on the left bank of the Courantyne River at its broad mouth, a colony of this species had a nest approximately 12×18 meters in diameters. The ants nested just above the waterlogged soil in yellow sand under trees. From the nest radiated numerous well-defined runways, one of which being traced for 78 meters and was mostly 40-60 cm. broad but was in places 17-160 cm. broad. Another trail was 85 miles along and mostly 10-20 cm. broad, paralleling the

other for some distance, and both lead to trees whose leaves were being cut. A trail on the opposite (west) side of the nest was traced 125 meters to a small tree which was about 75% denuded of its leaves.

A very young Forest Settlement colony was collected and placed in an observation nest (Plate 8). The queen and her young brood and workers consisting of minima and small media had a small nest in sand in second growth scrub forest. Under an inconspicuous crater 6.5 cm. in diameter was the single chamber at a depth of 12.7 cm. but 7.6 cm. to one side of the opening. The chamber was 3.8 cm. high \times 4.4 cm. in diameter. The fungus garden had well defined bromatia and contained larvae and pupae which lacked mycelia. The colony was collected August 16 and on August 19 at 8 a.m. the ants were given pure organic chemicals for substrate: blood fibrin, peptose, dextrin and gelatin. By 9:45 a.m. the ants had piled sand on the liquefied peptose but the remaining chemicals were untouched. Within two days all chemicals had been removed by the ants except the liquefied peptose. August 21 at 3:40 p.m. the ants were given hemoglobin, egg albumen, diastase and maltose on separate squares of paper. By 5:15 the squares remained untouched. There were numerous tiny amber fecal droplets on the garden. At 5:45 a minima worker was watched while tasting maltose. For several minutes it would taste the chemical, then leave, only to return repeatedly. At 5:47 a media worker picked up a piece of hemoglobin, carried it about for a moment, then put it down. The worker then went to the pile of dextrin and spent some moments lapping it. After darkness fell at 6:45 p.m. the ants were found to have taken all of the maltose. At 7 a.m., the next morning the ants were found to have removed practically all of the hemoglobin as well. The egg albumen and diastase had soaked into the paper but some must have been removed. Under the hand lens hemoglobin fragments could be seen to have tufts of mycelium. The ants had apparently defecated on the chemical. On August 25 at 7 a.m. the ants were given farine for substrate. Within three days it had been thoroughly incorporated into the fungus garden and most of the particles had turned to a buff color from white, indicating that they had been defecated upon. All of the particles had mycelial growth as well. Some had bromatia resting on or attached to them.

August 29 at 9:30 a.m. a minima worker was watched rotating a bromatium between its mandibles and fore legs until it had become distinctly smaller. Then the ant walked over to a shining larva which was longer and bulkier than the nursemaid. The mouthparts of the larva were somewhat extruded. The ant placed the bromatium on these mouthparts, the larva lying on its back, and the larva commenced to feed. The mouthparts went in and out with a piston-like motion. Within two or three minutes the bromatium had been eaten but the larva maintained the working of its mouthparts. The colony was given more farine on this day.

September 4 at 9:52 a.m. the ants were given more chemicals for substrate: blood fibrin, egg albumen, gelatin, peptose, diastase, dextrin and maltose; they immediately investigated the maltose, then the egg albumen. By 10:08 they had covered the peptose with sand grains and had carried off masses of the maltose and blood fibrin. Two workers were revolving a mass of maltose between them, one ant finally carrying it away to a position beside the peptose pile. The fungus garden had become somewhat dry though healthy in appearance and studded with bromatia. Eggs, larvae and pupae were all clean and shining. The queen was in her customary position beside the garden. By 11:40 a.m., the blood fibrin had all been removed, the egg albumen all covered with sand grains and the diastase partly so. A worker was watched for five minutes while carefully cleaning or licking a piece of blood fibrin which had been placed on top of the garden. The ant licked all sides of it, then left the chemical on the garden.

The little colony was ended September 8, 23 days after collecting, and while still in a fair condition. The fungus garden was dry and the ants seemed to have eaten all of the bromatia. They had chewed up the paper squares. Eggs, larvae and pupae were present and all free from mycelia. The highly artificial substrate had served directly as food and indirectly as a support for the fungus.

Atta laevigata F. Smith

Cat. Hym. Brit. Mus., 6:182, 1858, worker.

The record is based on workers from Rockstone and Saveritik forest by Wheeler (1916) and specimens from Kuruduni, Mabura, Canister Falls, Seba, Mackenzie and Yarovakuri by Menozzi (1935). This is a striking species and I saw

it along the Orinoco River, Venezuela only on the llanos north of Ciudad, Bolivar. In my collection are the following unpublished records, including two from the Brazilian and Venezuelan borders:

Kuruabaru Ck., Cattle Trail Surv., IX.19, A. A. Abraham; São José, Rupununi Savannahs, 2.VI.35, J. G. Myers 5473, Kukenan R., Roraima dist., Venezuela, J. G. M. 3333.

It has not been observed by me in the rains forests of the colony and would appear to be a savannah species of the above localities; at least Rockstone, Saveritik, São José, Kuruabaru Ck., and vicinity of Canister Falls lie in Savannah areas.

Atta sexdens L. (Plate 7)

Syst. Nat. 10th ed., p. 581, 1758, worker.

Like *cephalotes*, Linnaeus recorded *sexdens* from "America meridionali" but referred to specimens from Rolander. The extensive descriptions of the habits of "*cephalotes*" by Schomburgk given above may refer in part to *sexdens* since he traveled in the territory of both species and *laevigata*. Wheeler (1916) referred to "workers of the typical form from Rockstone." This and *cephalotes* are the common leaf-cutters of the colony and may be expected to divide up the forested part of the colony, *cephalotes* in the west, *sexdens* in the east.

Unpublished localities for the species include the following from my collection:

Cuyuni R., Upper Essequibo, 15.XI.35, J. G. Myers 5631, no local, J. G. M. 5931, New R., 10.XII.35, J. G. M. 5861, Oronoque R., 24.XII.35, J. G. M. 5904, Courantyne R. nr. King Wm. Rapids 4.XI.38, E. R. Blake B3; Forest Settlement, Mazaruni R. 17-30.VII.35, N. A. Weber 285, 294, 334, 341, Hororabo above Kartabo, Mazaruni R., 14.VI.36, Hepseba, lower Courantyne, 7-8.VII.36, N. A. W. 548, Apura, Surinam side of Courantyne R., 9.VII.36, N. A. W. 549, Wonotobo Falls, up. Courantyne 11-13.VII.36, N. A. W. 556, 559, King Fred Wm. IV Falls, Surinam side of Courantyne R., 16.VII.36, N. A. W. 570-2, nr. outlet of New R., 18.VII.36, N. A. W. 576-7, Oronoque R., 2°42'N., 24-29.VII.36, N. A. W. 591, 599, 610.

As indicated above, *Atta cephalotes* and *A. sexdens* occur together at the junctions of the Mazaruni and Cuyuni Rivers. In the vicinity of the Forest Settlements nests of both species were found. The nests of *sexdens*, however, were generally in sand, those of *cephalotes* in clay. It was thought at the time that *sexdens* was a savannah species but this is not borne out by

subsequent records, only *sexdens* being found in the luxuriant rain forests of the Courantyne basin, for instance. Nevertheless *sexdens* nests at the Forest Settlement were generally occupying a different ecological niche from those of *cephalotes*.

One nest here was located in savannah vegetation at the very edge of the river. The nest could not readily be examined because a fierce-stinging dark brown wasp had a ribbed, cylindrical carton nest in a tree overhanging the nest. The wasps stung three times while I was cutlassing the vegetation to expose the nest.

Another nest was located on the bluff overlooking Kartabo Point from His Majesty's Penal Settlement (Plate 7, Fig. 2). Young specimens of the giant toad, *Bufo marinus* L., near here had on August 19 these ants in their stomachs at 10:30 a.m. (Weber, 1938). The toads had undoubtedly collected these ants before sunrise since the intensity of light during the day would be unbearable to a toad. On August 30 from 7:45 a.m. to 11 a.m., two East Indian laborers were employed digging into the bluff to expose the gardens of the *sexdens* nest. The soil was a yellow disintegrated gneiss or similar material with much mica. The workers unsuccessfully dug 5.5 meters into the bluff, a point 2.2 m. down and 1.7 m. from the side of the bluff, without exposing chambers although they were following tunnels of the ants.

A young nest had the opening closed one morning and was photographed (Weber, 1937, Fig. 4). This photograph was erroneously captioned *Atta cephalotes*. The nest was thus protected from excessive humidity from an impending shower.

At the very edge of the clearing, west, northwest from the Settlement a colony dwelled on the border of a swampy place. The ants were, on August 27 at 4-5 p.m., carrying tops of moss plants (large leaved and pale green) as well as miscellaneous leaf parts, some of which were dead and dry. The ants carried them into tunnels in the craters which led 15-25 cm. below the sand surface and were just above the water table. The tunnels evidently led some meters away to gardens which were not found in the limited time available. A nest of a yellow *Pheidole* occurred in the sand about the tunnels.

A nest at the edge of the clearing on the north side was excavated August 30. The nest was large and covered nearly all

of the sandy higher ground in front of the forest as this site. It covered an area roughly 15 meters in diameter. A garden was exposed at a depth of 33 cm. and was 14 cm. high \times 16 cm. in diameter. The garden was completely sessile and was surrounded on all sides except the bottom by a clear space. It was somewhat more compact than in *cephalotes* but was otherwise similar. The garden contained bromatia, larvae covered with a scanty mycelium and pupae which were heavily coated. Two alate females were in tunnels which led into more inaccessible gardens. At depths below 33 cm. additional gardens were exposed but were damaged by the laborers.

At a depth of about 40 cm. in the nest were tunnels of a termite, *Anoplotermes*, representing a new species according to Dr. A. E. Emerson. Phorid flies and other parasites were not seen in this partially excavated nest though they were looked for.

Since the nest occupied nearly all of the higher ground here the ants were forced to forage for leaves down the slopes to wet savannah vegetation. Their runways were well developed and extended some 40 meters away. Within the first 30 meters many of the runways were subterranean tunnels, in places 30 cm. deep. Directly south of this nest on a clayey ridge formed by the roadway through the savannah was an *Atta cephalotes* nest 178 meters distant.

Portions of a fungus garden of the *sexdens* nest were placed in three containers but 24 hours later they had deteriorated. They then contained no well developed bromatia and several pupae in view completely naked like the larvae. The ants had evidently fed on the mycelium normally covering these. The garden appeared more of the *Trachymyrmex* type than the *cephalotes* kind and included as substrate small woody particles as well as leaves. The woody particles had apparently been treated as the ants would leaves, triturating, then defecating on them. September 2 the contents of one container was chloroformed so that they could be examined more leisurely. The garden was studded with compact bromatia, both on the exterior and throughout the interior. The inside had much the same color as the outside but was somewhat lighter and more yellowish brown. Larvae and pupae were naked and glistening. There were very few workers of any size present so that the bromatia would appear to be a natural development of the fungus without needing the intervention of ants. The portion in a second container had

on September 4 a good growth of mycelium on a piece of grass stem. Dry grass stems and blades are a good substrate provided they are defecated on by the ants. This substrate was observed used by *Acromyrmex* (*Moellerius*) *balzani planorum* on the llanos of Venezuela and by another subspecies in Colombia as well as by *Mycetophylax brittoni littoralis* on the seashore of Trinidad. This particular piece was about 10 mm. long and was covered only by hyphae. A similar piece of grass stem had been discarded and was brown in color. Here in this container were typical bromatia and smooth and glistening larvae and pupae. Six hours later a minima worker was seen to give a bromatium to a larva lying obliquely on its dorsal surface, *i. e.* turned partly on one side. The larva grasped it readily with the mouthparts. Earlier the ants had been given maltose, dextrin, blood fibrin and gelatin to determine whether they would use these for substrate. The ants used the gelatin and dextrose with some maltose to seal the edges of the container, however. On the other side of the container workers of a common pest *Solenopsis* were busily engaged in removing the maltose. The active minima *Atta*s seemed capable of driving out the *Solenopsis* while nearby observation nests of *Cyphomyrmex*, *Apterostigma* and *Trachymyrmex* were successfully invaded.

Another nest which was close to one of *cephalotes* was that in the clearing about the native village of Hororaba a few mile up the Mazaruni from Kartabo Pt. and the Forest Settlement. The *cephalotes* nest was at the edge of the clearing, that of *sexdens* within the clearing in sandy loam in a cassava, melon and Tannia patch. The latter nest was an inconspicuous mound with low craters or merely bare holes for entrance. Few ants were above the nest and it may have been a colony whose members were largely exterminated by the natives.

While travelling by boat with a large crew of natives up the Courantyne River in July, 1936 as the guest of the British Section of the International Boundary Commission I had brief opportunities to examine the ant fauna during the noon stops and night camps. Above the mouth of the river *sexdens* was the only *Atta* encountered. The first nest found was at Heseba above Orealla Mission.

It was located on the east southeast slope of a white sand ridge probably 15-20 meters high just back of the camp on the edge of the river. Though the exposed soil was all sand the

ants had excavated deeply enough to bring up yellow sand with a little clay which was left on the craters. There were scores of craters of various sizes and ages, the oldest badly beaten down by the rains. The most recent had mere slits for openings through which the ants pushed coarse pellets of sand. The craters extended along the ridge about 18 meters and down the slope about six meters, occupying a roughly rectangular area. When the nest was disturbed the ants were pugnacious but were not nearly as effective as *cephalotes*, the soldiers being distinctly smaller. The single phorid fly collected was ovipositing on workers in the usual fashion, temporarily paralyzing them.

The next nest seen was at the Indian village of Apura, about half an hour's travel above the Dutch Mission of Washaba and on the Surinam side. The stop was for a few minutes only so that there was little time for observations. The ants had a populous trail, the workers carrying leaf sections in the bright morning sun. They were apparently cutting them from a dense growth of grass, bamboo and weeds on the river bank. *Mycocepurus smithi* had craters nearby.

At Wonotoba Falls a nest was found in wet yellow clay with some sand in heavy rain forest 17 meters west of the small clearing. At a depth of 60 cm. a chamber was exposed which was 24 cm. high x 30 cm. wide. Others were found at a similar level and of similar size. These were larger than those of *cephalotes*. The outer part of the gardens had somewhat larger open cells than those of *cephalotes* and the whole garden was much more compact. Externally the color was that of the Forest Settlement *cephalotes* or *sexdens* but internally more gray and less brown. The bromatia appeared to be not as well developed as in *cephalotes* but numerous and small. The substrate was miscellaneous, yellow to yellow brown to dark brown in color. Many phorid flies, all of large size, were parasitizing the workers and soldiers. They would alight just back of the head for a perceptible moment and the ants would act momentarily paralyzed. Both workers and soldiers could draw human blood with their mandibles if given a moment but ordinarily did not.

A portage or "drogh line" led around Wonotobo Falls, for "topside" travel, through heavy rain forest and over jagged rocks of the escarpment. Along this portage several files of *sexdens* were seen.

At King Frederick William IV Falls, largest of those on the Courantyne, the ants were encountered on an island on the Surinam side over which a portage or "drogh line" $1\frac{1}{2}$ miles long extended. At 3 p.m. soldiers and workers were carrying leaves in the heavy rain forest and one worker was carrying a piece of twig. By flashlight that night (7-8:30 p.m.) the ants were seen busily at work in the eerie, dark gloom. A soldier was watched cutting a leaf section. The ants made a rustling sound as they cut leaves and walked over dry leaves with their burdens in the largely calm night.

Along the New River, near its outlet with the Courantyne, the ants had a large nest near nests of *Acropyga* (*Rhizomyrma*) *goeldii* Forel in Brazil nut shells in high forest. The *Attas*, however, did not have craters but only simple holes in the well-drained light soil. Possibly rains washed away craters in the friable soil as soon as they were formed. There were many holes over a large area but there was no time for study. The ants were busy carrying in green leaf sections.

Above King Edward VII Falls of the New River a diffuse nest with small openings on a large mound was encountered. The mound, however, appeared to have been thrown up by some mammal. The ants were carrying leaves at 5 p.m. and again after dark at 7 p.m. The soil here was white sand and nearby were nests of *Trachymyrmex guianensis* and *trifucatus*.

Near the outlet of the Oronoque River with the New River several nests were found. One nest extended to the base of a large Brazil Nut tree (*Bertholletia* sp.) which was, at a height of two meters, 597 cm. in circumference. The nest was 12.9×5.9 meters in diameter and attained a height of 85 cm. A new crater at the edge of the nest was 54 cm. high. This appeared to be a mature nest and openings were largely confined to the periphery. The 54 cm. high crater had, besides the central opening, a small opening at the base in front through which a few workers were bringing in leaf sections and pieces of dried flowers which lacked their petals. A score or more meters away was a much larger nest and the species appeared to be abundant on the ridge at this site. At these larger nests the ants were chiefly active above ground at night while at nearby much younger nests workers were excavating soil throughout the day.

Two such young nests had crater openings 29 cm. apart July 24. One had a simple crater mound with an opening which

led at a slight angle to a chamber about 30 mm. in diameter in which was the fungus garden. The other had a turret 20 mm. high on a crater 20 mm. high, this turret or chimney having an opening 9 mm. in diameter. At a depth of 60 mm. was a fungus garden in a chamber about 30 mm. in diameter and spherical. The chamber was 70 mm. to one side of a point directly beneath the opening. Each contained a queen with minima workers and brood. At a distance of 460 cm. was a nest of *Myrmicocrypta guianensis* which was externally very similar. The colonies were taken alive by a devious route some thousands of miles via airplane, steamship and railways to the University of North Dakota, U.S.A. The queens outlasted most of their broods and one died early in October, the other October 22. The October 22 queen still had a tiny fungus garden when preserved.

At this site the only male seen was a single insect which came bumbling along July 29 and fell into the river as I was bathing at 6:15 p.m. during a light shower which started 15 minutes earlier. There was no other indication of a marriage flight. Similarly a single male *Acromyrmex octospinosus* was the only male of the genus found in this area and was taken July 26.

Literature Cited

- Davis, T. A. W. and Richards, P. W., 1933-4, The vegetation of Moraballi Creek, British Guiana: An ecological study of a limited area of tropical rain forest. Parts I and II. — Jour. Ecol. 21: 350-384, 22: 106-155.
- Martyn, E. B., 1931, A botanical survey of the Rupununi Development Company's ranch at Waranama, Berbice River. — Agr. Jour. B. Guiana, 4: 18-25, 2 pl.
- Schomburgk, Richard, Travels in British Guiana 1840-4. 2 vols. Transl. by W. E. Roth, Georgetown, B. G., 1922.
- Squire, F. A., 1933. British Guiana Department of Agriculture 1933. Report of the Entomological Division for the year 1932, Georgetown, B. G., pp. 135-140.
- Weber, N. A., 1937a, The biology of the fungus-growing ants. Part II. Nesting habits of the bachac (*Atta cephalotes* L.). — Tropical Agriculture, 14: 223-226, 8 fig. Trinidad, B. W. I.
- 1937b. The biology of the fungus-growing ants. Part I. New forms. — Rev. Ent. 7:378-409.
- 1938a. The biology of the fungus-growing ants. Part III. The sporophore of the fungus grown by *Atta cephalotes* and a review of reported sporophores. — Rev. Ent. 8: 265-272.
- 1938b. The biology of the fungus-growing ants. Part IV. Additional new forms. Part V. The Attini of Bolivia. — Rev. Ent. 9: 154-206.
- 1938c. The food of the giant toad, *Bufo marinus* (L.), in Trinidad and British Guiana with special reference to the ants. — Ann. Ent. Soc. Amer. 31: 499-503.

- 1940. The biology of the fungus-growing ants. Part VI. Key to *Cyphomyrmex*, new Attini and a new guest ant. — Rev. Ent. 11: 406-427.
- 1941. The biology of the fungus-growing ants. Part VII. The Barro Colorado Island, Canal Zone, species. — Rev. Ent. 12: 93-130.
- 1941. The rediscovery of the queen of *Eciton (Labidus) coecum* Latr. (Hym.: Formicidae). — Amer. Midl. Nat. 26: 325-329.
- 1945. The biology of the fungus-growing ants. Part VIII. The Trinidad, B. W. I. species. — Rev. Ent. 16: 1-88.
- Wheeler, W. M., 1916. Ants collected in British Guiana by the expedition of the American Museum of Natural History during 1911. — Bull. Amer. Mus. Nat. Hist. 35: 1-14.
- 1921. A study of some social beetles in British Guiana and of their relations to the ant-plant *Tachigalia*. — Zoologica, 3: 46-47, 162.
- 1925. Neotropical ants in the collections of the Royal Museum of Stockholm. — Ark. för zool., 17: 1-55.
- 1937. Mosaics and other anomalies among ants. Harvard Univ. Press, 95 pp.

Notes on the Tropical American Species of the Genus *Tipula* Linnaeus (Tipulidae, Diptera). Part III.

By Charles P. Alexander, Massachusetts State College,
Amherst, Massachusetts

(With 7 figures)

In the first part under this general title (Rev. de Entomologia, 16: pp. 330-356; 1945) I prepared an account of the subgenus *Microtipula* Alexander, indicating that in a future report the subgenus *Eumicrotipula* Alexander would be treated in similar manner. Accordingly I am presenting herewith a discussion of this subgenus, the largest and most characteristic group of Tipulidae in Tropical America.

Eumicrotipula Alexander

Eumicrotipula Alexander; Bull. Mus. Hist. Nat., Paris, 1922: 74-75; 1922; (type: *macrotrichiata* Alexander 1922).

As indicated in the earlier report above cited, the present subgenus was based upon a very small Tipuline fly having abundant macrotrichia in the outer cells of the wing. Since the original definition, a large number of species have been discovered and our conception of the subgeneric limits has been modified so as to include not only the small species that center about the typical form but also the more numerous species belonging to the so-called *glaphyroptera* and *monilifera* groups,